TTI 1140

UNIVERSAL TRANSMISSION MEASURING SYSTEM (UTMS)™

INSTRUCTION MANUAL

Telecommunications Technology, Inc.

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USING THE TTI 1140 UTMS INSTRUCTION MANUAL WITH THE KS-20805 TMS

This manual covers the TTI 1140 UTMS, which is manufactured for Western Electric as the KS-20805 TMS. These two transmission measuring systems are identical except for certain equipment options and nomenclature differences.

The differences between the two systems are as follows:

1. The KS-20805 does not include the calibration standard, which is available as optional equipment with the TTI 1140.

2. All KS-20805 systems are equipped with −48 Vdc power supplies. The TTI 1140 may be optionally equipped with a 115 Vac power supply.

3. The vertical panel mount display housing (1140A-2, List 12) is not currently available with the KS-20805.

4. Two noise weighting networks (C-message and 3-kHz flat) are included as part of the KS-20805 Common Measuring Equipment, List 1. One additional network (List 5 or List 6) may be optionally included.

5. The KS-20805 is equipped with a 20-kHz lowpass filter which restricts the frequency range for level measurements to 20-kHz and below. The 20-kHz Lowpass Circuit board, part number P1140-167, replaces the Level Filter substitute circuit board (P1140-061) or the Level Filter circuit board (P1140-205). This is the only change to operating specifications. In view of this difference, the following two 1140 options are not available with the KS-20805:
   a. 50-kb/s data filter, 1140D-2 List 6.
   b. Provision for 135-ohm impedance.

Since the KS-20805 TMS and the TTI 1140 UTMS are electrically identical (with the exception of the equipment options noted), this manual is fully applicable to the installation, operation, and troubleshooting of the KS-20805 TMS.

For quick reference, the table on the following page shows which of the 1140 part numbers are included in each of the KS-20805 list designations.

Each KS-20805 list designation. . .includes these 1140 parts		
	Qty	Item
Common Measuring Equipment, List 1	1	Equipment Shelf, 1140A-2 List 1
	2	Scanning lockout switch 1140A-2 List 3
	1	−48 Vdc power supply 1140A-2 List 5
	1	Level measuring unit 1140B-2 List 1 (equipped with 20-kHz lowpass filter)
	1	Frequency measuring unit 1140C-2 List 1
	1	Noise measuring unit 1140D-2 List 1
	1	C-message filter 1140D-2 List 2
	1	3-kHz flat filter 1140D-2 List 3
Display, List 2	1	Display housing, aisle mount 1140A-2 List 9
	1	Display, large level, 1140B-2 List 4
	1	Display, large frequency, 1140C-2 List 3
	1	Display, large noise, 1140D-2 List 8
Display, List 3	1	Display housing, rack mount, 1140A-2 List 8
	1	Display, small level, 1140B-2 List 3
	1	Display, small frequency, 1140C-2 List 2
	1	Display, small noise, 1140D-2 List 7
Display, List 4	1	Display housing, horizontal panel mount, 1140A-2 List 10
	1	Display, small level, 1140B-2 List 3
	1	Display, small frequency, 1140C-2 List 2
	1	Display, small noise, 1140D-2 List 7
Filter, List 5	1	Program filter, 1140D-2 List 4
Filter, List 6	1	15-kHz flat filter, 1140D-2 List 5

INSTRUCTION MANUAL

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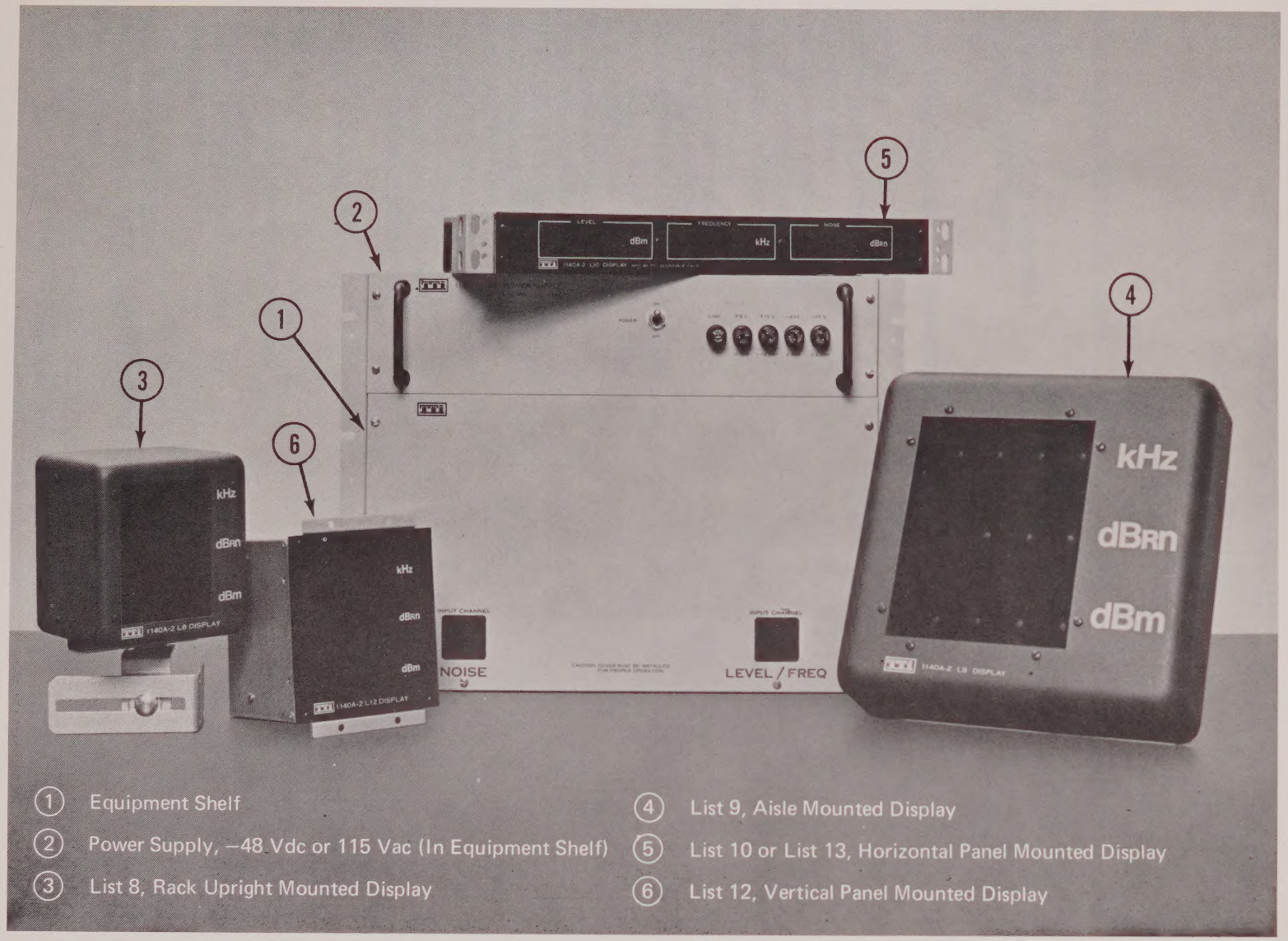
1 Equipment Shelf
2 Power Supply, −48 Vdc or 115 Vac (In Equipment Shelf)
3 List 8, Rack Upright Mounted Display
4 List 9, Aisle Mounted Display
5 List 10 or List 13, Horizontal Panel Mounted Display
6 List 12, Vertical Panel Mounted Display
NOISE
LEVEL / FREQ
kHz
dBrn
dBm

Figure 1-0. TTI 1140 UTMS Equipment.

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Produced By Winston Advertising Inc.

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM (UTMS)*

INSTRUCTION MANUAL

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SECTION 1

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM(UTMS)*

DESCRIPTION AND OPERATION

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3. SPECIFICATION SUMMARY 1-3

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1. GENERAL

1.01 This section describes the TTI 1140 UTMS and the procedures for operating the system. Functional circuit description, trouble locating, and installation information are covered by separate sections contained in this manual.

1.02 If so equipped, the TTI 1140 can measure up to three of the following voice-frequency transmission parameters:

Transmission level (dBm).
Signal Frequency (kHz).
Message circuit noise (dBrn).

The TTI 1140 is intended for use in toll test boards, carrier equipment bays, circuit and repeater bays, automatic test frames and in other facilities where transmission measurements are desirable. The TTI 1140 is a modular system and consists of:

a. Equipment Shelf (TTI 1140A-2 List 1), which may consist of:

1. —48 Vdc Power Supply (TTI 1140A-2 List 5) or

2. 115 Vac Power Supply (TTI 1140A-2 List 7).

3. Scanning Lockout Switches (TTI 1140A-2 List 3).

4. Level Measuring Unit (TTI 1140B-2 List 1).

5. Frequency Measuring Unit (TTI 1140C-2 List 1).

6. Noise Measuring Unit (TTI 1140D-2 List 1).

7. Calibration Standard (TTI 1140A-2 List 4).

b. Remote Displays (TTI 1140A-2 List 8,9,10, 12 and 13) and their corresponding display circuit boards; level, noise, and frequency.

For more detailed equipment information, refer to Section 4, Installation Drawing J1140-001 Sheet 2 (Stock List and Table A).

1.03 The equipment shelf is rack mounted to either a 19-inch or 23-inch bay having 12-inch guard rails. The equipment shelf accommodates all measuring circuitry, power supply, scanning lockout switches and calibration standard mentioned in Paragraph 1.02a of this section (Items 1 thru 7). The equipment shelf is equipped with twenty input channels. Ten input channels are dedicated to level and frequency measurements both of which are generated from a single input. The other ten input channels are dedicated to noise measurements, which requires an input separate from the level/frequency input. The TTI 1140 can drive up to ten of the remote displays mentioned in paragraph 1.02b of this section. Any combination of the four styles may be used (See Installation Drawing J1140-002 Sheets 1 and 2 in section 4 of this manual).

1.04 There are five types of digital display units. All are capable of the simultaneous display of level, frequency, and noise, if so equipped. The TTI 1140A-2 List 9 display is a large display with readouts arranged vertically and is intended to be mounted overhead in the aisle (See Installation Drawing J1140-003). The TTI 1140A-2 List 8 display is a smaller display with readouts arranged

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vertically and is intended to be mounted to the upright of an equipment rack (See Installation Drawing J1140-004). The TTI 1140A-2 List 10 and List 13 displays are small displays with readouts arranged horizontally and are intended to be flush mounted to either a 19-inch or 23-inch frame (See Installation Drawing J1140-007). The TTI 1140A-2 List 12 display is a small display with readouts arranged vertically and is intended to be flush mounted to the equipment panel (See Installation Drawing J1140-008).

1.05 Two noise weighting networks are included as part of the optional noise measuring unit (TTI 1140D-2 List 1). These are the C-message (Filter #1) and the 3-kHz flat (Filter #2). One additional noise weighting network may be selected as Filter #3. It may be either the program (TTI 1140D-2 List 4), the 15 kHz Program (TTI 1140D-2 List 5) or the 50 kb/s data (TTI 1140D-2 List 6). Selection of weighting networks (filters) for the individual input channels is made by strapping at the time of installation.

1.06 In addition to noise weighting networks, strapping at the time of installation permits the selection of the following options for each of the ten level/frequency and noise input channels discussed in Paragraph 1.03 of this section:

a. Frequency Resolution: 1 Hz or 10 Hz.
b. Display Selective Blanking.
c. Impedance: 600 or 900 ohms. (135 ohms may be ordered)
d. Filter (level/frequency): To be announced.

1.07 The strapping for these options is performed on the two optional scanning lockout switches (TTI 1140A-2 List 3), one for the ten level/frequency input channels and one for the ten noise input channels. Each scanning lockout switch functions as a programmer to select the various options for each input channel. The scanning lockout switch also selects a single input channel at a time, electronically locking other inputs out, to prevent double termination.

1.08 When the scanning lockout switches are not ordered with the TTI 1140, substitute multiple circuit boards are installed at the factory. When strapped during installation, all ten inputs to the level/frequency measuring circuitry are multipled (paralleled), and lockout protection and selective programming are not provided. The ten noise input channels are multipled in the same manner.

1.09 Periodic calibration checks can be performed on the TTI 1140 when the calibration standard option (TTI 1140A-2 List 4) is installed in the system. By accessing the input channels designated and wired for the calibrator, the TTI 1140 measures the calibrator output and the following readings are transmitted to and presented on the remote display or displays so designated:

a. Level (dBm): 0.0 dBm
b. Frequency (kHz): 1 kHz
c. Noise (dBrn): —45 dBrn

1.10 Either a 115 Vac (TTI 1140A-2 List 7) or a —48 Vdc (TTI 1140A-2 List 5) line input power supply is required to be installed in the TTI 1140.

2. EQUIPMENT ARRANGEMENT

2.01 Once the TTI 1140 is installed and operating, physical access to the equipment shelf is seldom required. Therefore the equipment shelf is generally installed in some convenient central location where rack space is not at a premium.

2.02 Access to each of the 20 input channels is normally provided by a jack. These jacks (or other means of access) may be located up to 250 feet from the equipment shelf with no significant measurement degradation due to cable attenuation. A busy lamp associated with each access point indicates whether the system is in use.

2.03 The digital displays TTI 1140A-2 List 8, 9, 10, 12 and 13 and associated display circuit boards may be located at any convenient point within 1,000 feet of the equipment shelf. Since these displays are driven by binary-coded decimal (BCD) signals from the measuring circuitry in the equipment shelf, cable attenuation is not a factor in measurement accuracy.

3. SPECIFICATION SUMMARY

Level Range	−50 dBm to +10 dBm
Frequency Range	100 Hz to 50 kHz (Can be used outside this range, as indicated below)
Noise Range	0 dBrn to 60 dBrn
Input Impedances	600 and 900 ohms ±0.2% balanced or unbalanced (135 ohm option is available) bridging is 200 K ohms minimum
Blanking	Automatic blanking, (+) sign remains on above and (−) sign remains on below the measurement range.

Level Measurement

Resolution	0.1 dB
Accuracy	±0.1 dB
Variation vs. frequency	100 Hz to 5 kHz: ±0.02 dB 100 Hz to 20 kHz: ±0.04 dB 100 Hz to 50 kHz: ±0.07 dB 60 Hz to 100 Hz: ±0.2 dB 50 kHz to 60 kHz: ±0.1 dB
Variation vs temperature	0° to 50°C: ±0.002 dB/°C
Variation vs AC power	±10%: less than 0.01 dB
Detector type	Averaging
Display	3 digits and plus/minus sign
Refresh Rate	125/second

Noise Measurement

Resolution	1.0 dB
Accuracy	±1 dB
Variation vs frequency	Filter dependent; 100 Hz to 50 kHz: within 1 dB
Variation vs temperature	0° to 50°C: ±0.02 dB/°C
Variation vs AC power	±10%: less than 0.1 dB
Detector type	Quasi-rms
Display	2 digits and plus/minus sign
Refresh rate	200/second

Frequency Measurement

Resolution	1.0 Hz or 10 Hz (strap selectable)
Accuracy	1 part in 10^5 ±1 digit

Frequency Measurement (Continued)

Minimum input level	100 Hz to 50 kHz: —49.9 dBm 60 Hz to 100 Hz: —29.9 dBm 50 kHz to 60 kHz: —29.9 dBm
Display	4 digits
Refresh rate	9/sec @ 1-Hz resolution 90/sec @ 10-Hz resolution

Auxiliary Connections

Internal clock output	1 kHz
Sample/inhibit control	External ground holds BCD output signals
Access-identification output	Parallel BCD (TTL levels)
Power Supply	—48 Vdc, or 115 Vac
Power Consumption	180 watts (max) for the equipment shelf. This includes allowances for up to 10 displays (with three display circuit boards in each display housing)
Mechanical Characteristics	Reference Installation "J" Drawings in Section 4 of this manual.

4. OPERATION

4.01 To obtain a measurement with the TTI 1140, it is necessary to connect the circuit to be tested to the appropriate input: the level input for level/frequency measurements, and the noise input for noise measurements. This input connection is normally through an input access jack (See Installation Drawings S1140-B01 Sheets 1, 2, 3, and 4 in Section 4 of this manual). Depending on the specific installation arrangement, however, it may be made by other means such as a key, also shown on the drawing. In any case, connecting the test circuit to the level/frequency input provides an immediate display of both transmission level and test signal frequency. Connecting the test circuit to the noise input provides an immediate display of the message circuit noise. Since the TTI 1140 uses automatic range selection in both the level/frequency measuring circuitry and the noise measuring circuitry, no range selection or other adjustment is necessary to obtain an accurate reading.

4.02 Level/frequency measurement access is independent of noise measurement access. Thus, level/frequency measurements can be made on one circuit while noise measurements are made on another circuit.

4.03 Level is measured in dBm and is displayed in the three digits to a resolution of 0.1 dB. The level measurement range is —50 dBm to +10 dBm. An illuminated plus or minus sign indicates whether the measurement is above or below 0 dBm. If the signal level exceeds +10 dBm, the level display is automatically blanked (out-of-range blanking) and the plus sign remains on to show that the signal level is above the TTI 1140 measurement range. If the signal level drops below —50 dBm, the display is automatically blanked (out-of-range blanking) and the minus sign remains on to show that the applied signal is below the TTI 1140 measurement range.

4.04 Since the frequency measuring unit obtains its input from the level measuring unit, the operating level range is the same for both: —50 dBm to +10 dBm. Any signal level out of this range also results in blanking (out-of-range blanking) of the frequency display. The out-of-range condition is then indicated by the plus or minus signs on the level display, as described in Paragraph 4.03 above. Frequency is displayed in four digits to a resolu-

tion of 1-Hz or 10-Hz. These resolutions are strap selectable at the strapping board associated with the level/frequency input (See Section 2, Paragraph 5). The complete frequency measurement range is 60-Hz to 60-kHz. At either of the two resolutions, the frequency display indicates the last four digits of the frequency measurement. When the selected input channel is strapped for a resolution of 10-Hz, frequencies up to 60-kHz are displayed directly. When the selected input channel is strapped for 1-Hz, frequencies up to 9.999-kHz are displayed directly.

4.05 Noise is measured in dBrn and is displayed in two digits to a resolution of 1 dB. The noise measurement range is 0 dBrn to 60 dBrn. If the signal applied to the noise measuring unit exceeds 60 dBrn, the noise display automatically blanks (out-of-range blanking) and the plus sign remains on to show that the signal level is above the TTI 1140 measurement range. If the signal level drops below 0 dBrn, the display is automatically blanked (out-of-range blanking) and the minus sign remains on to show that the signal is below the TTI 1140 measurement range.

4.06 Strap-selectable weighting networks in the noise measuring unit determine the weighting characteristics of the noise measurement. The noise measuring unit includes a C-message and a 3-kHz weighting network as standard equipment. One optional weighting network, program, 15-kHz program, or 50-kb/s data, may be included. The weighting characteristic for a measurement made from a specific noise access appearance depends on which weighting network is strapped for that appearance on the noise strapping circuit board. At the present time, no level filters are available on the level filter circuit board. However filters will be available in the future and announced.

4.07 When the calibration standard is used, a specially designated key or switch is depressed and both level/frequency and noise input channel 10 are activated. Then the calibration standard circuit board supplies the measuring circuitry with; 0.0 dBm of simulated signal level, 1-kHz of simulated signal frequency, and 45 dBrn of simulated message noise. All displays operating unblanked, and the display connected to BCD-output position 10, display the parameters mentioned above for as long as the calibrate key is depressed. This option requires scanning lockout switches.

SECTION 2

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM (UTMS)

FUNCTIONAL CIRCUIT DESCRIPTION

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1. GENERAL

1.01 This section describes the TTI 1140 Universal Transmission Measuring System (UTMS) on two levels, as follows:

a. Paragraph 2 is a system overview.

b. Each succeeding paragraph (3 thru 10) gives a brief circuit description of one of the eight functional units in the TTI 1140.

These eight units are:

a. Equipment shelf.
b. Power supply and regulation (—48 Vdc and 115 Vac).
c. Scanning lockout switches and substitute multiple circuit boards.
d. Level measuring unit.
e. Frequency measuring unit.
f. Noise measuring unit.
g. Digital displays (List 8, 9, 10 and 12).
h. Calibration standard.

1.02 The functional circuit descriptions correlate with the flow diagram(s) contained at the end of the corresponding paragraph. For example, the —48 Vdc Power Supply and Regulation flow diagram is located at the end of the —48 Vdc and 115 Vac Power Supply Functional Circuit Description.

2. SYSTEM OVERVIEW

2.01 Depending on the power supply used, the TTI 1140 receives either —48 Vdc or 115 Vac line voltage input. The 1140 receives its signal input from any of 20 input channels or from the calibration standard on channel 10, if this option is used. Ten of these channels are for the simultaneous measurement of transmission signal level and frequency. The other 10 channels are for noise measurement. As shown in Figure 2-1, the signal path for level/frequency measurement is entirely separate from the signal path for noise measurement. Thus, both types of measurements can be made simultaneously.

EQUIPMENT SHELF

2.02 As Figure 2-1 shows, all measuring circuitry (frequency, noise, and level), the power supply, the scanning lockout switches (or the substitute multiple circuit boards), the calibration standard, input power and input signal wiring are all incorporated in the equipment shelf. The equipment shelf BCD-output distribution in turn provides wiring to the TTI 1140 digital displays. Refer to Installation Drawing J1140-002 Sheets 1 and 2 for a complete mechanical description of the

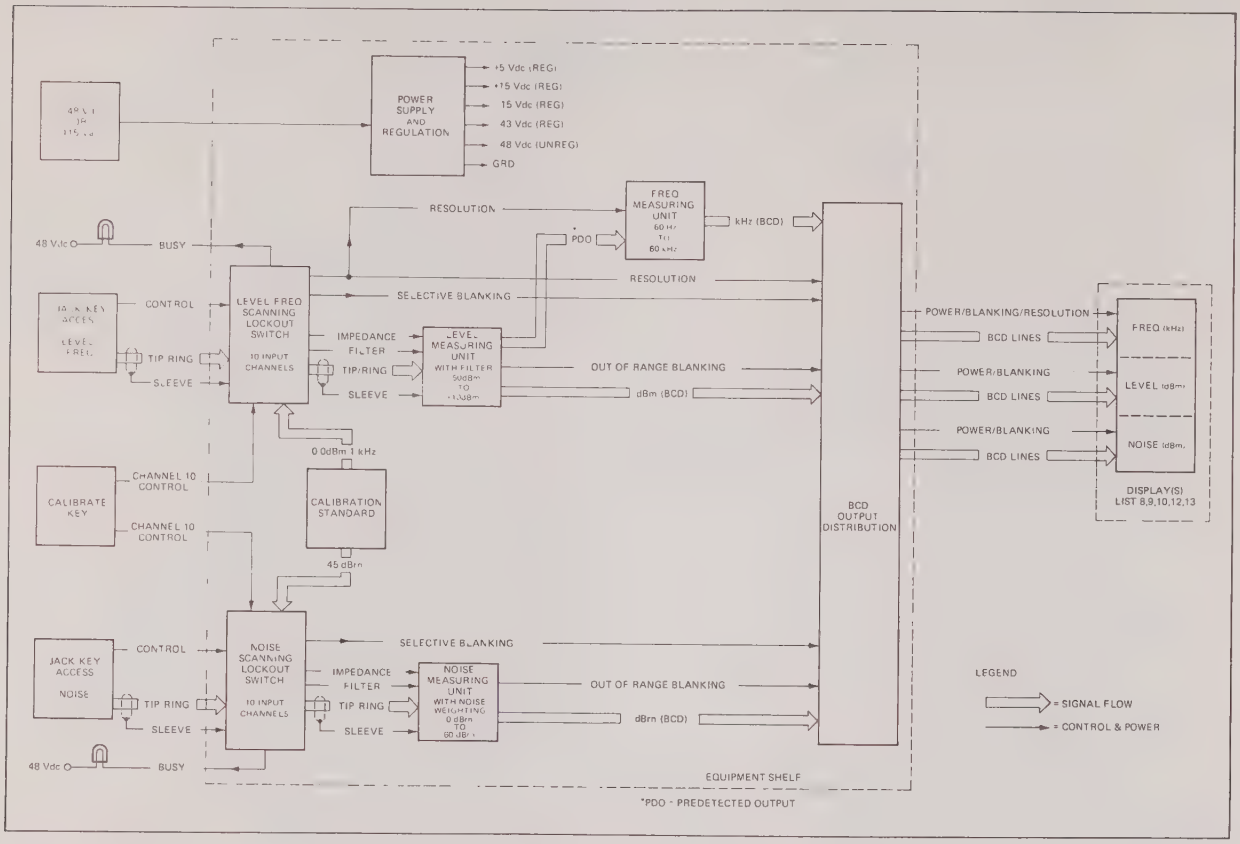


Figure 2-1. TTI 1140 Simplified Block Diagram.

equipment shelf, its contents and its input and output connections.

POWER SUPPLY & REGULATION

2.03 The TTI 1140 must be equipped with one of two available power supplies. They are the —48 Vdc and the 115 Vac line voltage input units. The —48 Vdc power supply receives —48 Vdc office battery and frame ground from the test facility fuse panel and in conjunction with the two dc regulators (one for level/frequency circuitry and one for noise circuitry), generates the five voltages shown below:

a. +5 Vdc (regulated).
b. +15 Vdc (regulated).
c. —15 Vdc (regulated).
d. —43 Vdc (regulated).
e. —48 Vdc (unregulated).

2.04 The 115 Vac power supply receives 115 Vac—hot, return, and ground from the test facility fuse panel and in conjunction with the two dc regulators generates the same voltages as the —48 Vdc power supply.

2.05 Once the TTI 1140 is installed, the power switch on the front cover of the power supply (on the equipment shelf) is normally ON, which ensures that the system is always ready for office testing.

LEVEL/FREQUENCY MEASUREMENT

2.06 The signal to be measured is normally applied to the TTI 1140 through a jack or key access point. For a terminated measurement, a terminating resistor of the appropriate impedance is installed at the access point. If no terminating resistor is installed at the access point, a bridged measurement will result, since the TTI 1140 operates in a bridging mode.

2.07 As shown in Figure 2-1, contact closures at the jack or key send a control signal and the

signal to be tested to the scanning lockout switch. The scanning lockout switch selects the specific level/frequency input channel for a measurement and locks out the other nine level/frequency input channels. This ensures that there is no possibility of a double termination or interference from other users, even if a circuit is connected to one of the other nine input channels. In addition to providing input channel selection and positive lockout protection, the scanning lockout switch controls the busy lamps and the selection of the following strapping options:

a. Frequency Resolution.
b. Display Selective Blanking.
c. Terminating Impedance.
d. Filter (To Be Announced).

These options are pre-programmed into the scanning lockout switch at the time of installation.

2.08 When the substitute multiple circuit boards are used in lieu of the scanning lockout switches, all ten level/frequency input channels are multipled (paralleled). Only one position must be accessed at a time to prevent double termination. In addition, automatic channel selection, positive lockout protection and control of individual busy lamps is not provided when these circuit boards are used (See Installation Drawing S1140-B01 Sheet 2, Figures 1 and 2). Hence forth, ALL discussions assume the use of scanning lockout switches.

2.09 The scanning lockout switch routes the signal to the level measuring unit, where it is amplified and routed through the level filter circuit board (no input filtering is presently provided). The next step is automatic range adjustment of the test signal (in 10 dB steps) to bring it within the 10 dB range of the detector and digital encoding circuitry. This "predetected" signal provides the input (PDO) to the frequency measuring unit and to the additional stages of the level measuring unit. The additional level stages detect, filter, perform log conversion and digitally encode the result in parallel binary coded decimal (BCD) format. The BCD signal is sent to the BCD-output distribution section of the equipment shelf and routed to the digital displays.

2.10 The level measuring unit receives impedance-selection control from the level/frequency scanning lockout switch. Out-of-range blanking control (OOR) is sent by the level measuring unit to the BCD-output distribution section for routing to the digital displays. The scanning lockout switch provides selective blanking directly to the BCD-output distribution, without going through the level measuring unit.

2.11 As shown in Figure 2-1, the input signal to the frequency measuring unit is the predetected output(PDO) from the level measuring unit (Paragraph 2.09 in this section). The input signal controls the frequency of an internal phase-locked oscillator so that its frequency is held at 10 times the input signal frequency. The frequency of this internal oscillator is then counted. (This times 10 multiplication* permits faster counting than would otherwise be possible.) The count is sent in parallel BCD format to the BCD-output distribution section of the equipment shelf and routed to the digital displays.

2.12 The frequency measuring unit receives resolution control from the level/frequency scanning lockout switch. Frequency display blanking (selective blanking and out-of-range blanking) is controlled by the level measuring unit.

NOISE MEASUREMENT

2.13 As shown in Figure 2-1, the noise scanning lockout switch selects an input channel to be routed to the noise measuring unit in exactly the same way as the level/frequency scanning lockout switch selects a channel for the level measuring unit (See Paragraphs 2.08 and 2.10 in this section). The only difference between the two scanning lockout switches is in the strapping (performed at time of installation). The noise scanning lockout switch controls the selection of the following strapping options:

a. Display selective blanking.
b. Terminating impedance.
c. Noise weighting network.

In addition, the scanning lockout switch provides display selective blanking directly to the BCD-output distribution section without going through the noise measuring unit. (See paragraph 2.08 in this section for the operation of the substitute multiple circuit boards in lieu of the noise scanning lockout switch.)

2.14 The input signal to the noise measuring unit first goes through the selected noise weight-

*U.S. Patent No. 3,701,953.

ing network, then to the automatic range selection circuitry, which converts the signal level so that it falls within the proper 10 dB range for application to the succeeding stages. These stages detect, filter, perform log conversion and encode the result in parallel BCD format. This BCD signal is sent to the BCD-output distribution section of the equipment shelf and routed to the digital displays.

2.15 The noise measuring unit receives control of impedance and noise weighting network selection directly from the scanning lockout switch. The noise measuring unit provides out-of-range blanking control to the BCD-output distribution section for routing to the digital displays.

DIGITAL DISPLAYS

2.16 Each digital display housing (TTI 1140A-2 List 8, 9, 10, and 12) if so equipped contains three separate circuit boards to display the three parameters: level, frequency, and noise. The digital displays receive the following signals from the BCD-output distribution section at the rear of the equipment shelf:

a. Parallel BCD signal of level, frequency, or noise measurement information (if the equipment shelf is so equipped).

b. Power (+5 Vdc, +15 Vdc, −43 Vdc and ground).

c. Blanking (selective and out-of-range).

d. Resolution (1-Hz or 10-Hz for frequency display circuit boards only).

NOTE

Henceforth, the presence of ALL the display circuit boards (frequency, noise, and level) in the digital display housing(s) under discussion is assumed.

2.17 Each of the display circuit boards decodes its own BCD-input and displays the measurement information on the Nixie display tubes located on the circuit board. In the case of the frequency display circuit board, the resolution information from the strapping circuit board is used to select one of the two light-emitting diodes (LED) which are used as decimal point indicators.

2.18 Each of the display circuit boards receives out-of-range blanking commands. If the input signal to the level or noise measuring unit goes above or below the measurement range, the display associated with that parameter is automatically blanked, except for a "+" or "—" sign. The sign indicates whether the input signal is above or below the measurement range. Blanking commands to the frequency display circuit boards are the same as those to the level display circuit board. Thus, these two display boards blank together. The "+" and "—" signs on the level display circuit board indicate out-of-range conditions for both level and frequency.

2.19 Each of the individual displays can be separately strapped for blanked or unblanked operation. In unblanked operation, the display provides a reading regardless of which input channel is selected. In blanked operation, the display only provides a reading when the corresponding input channel is selected.

CALIBRATION STANDARD

2.20 As shown in Figure 2-1, contact closure at the calibrate key causes a control signal to be applied to channel 10 of the level/frequency and the noise scanning lockout switches, energizing the channel 10 tip/ring relays. Since the calibrator output to the level/frequency circuitry (0.0 dBm at 1 kHz) is always applied to the channel 10 relay, once energized, the relay contacts route the simulated test signals directly to the measuring circuitry. Channel 10 in the noise scanning lockout switch functions in the same manner. The level/frequency and noise measuring circuits measure the signals and transfer them, in BCD format, to the BCD-output distribution section of the equipment shelf. From the BCD-output distribution section, the parallel BCD signals are applied to all digital displays connected to the equipment shelf. However, only those digital displays operating unblanked, and the display connected to BCD-output position 10, will display the values transmitted to them. Once the calibrate key is released, channel 10 relays will de-energize and the scanning lockout switches revert to the scanning mode discussed in previous paragraphs in this section. Scanning lockout switches are required when the calibration standard is used.

3. EQUIPMENT SHELF

3.01 The equipment shelf is the mechanical basis for the TTI 1140. It accepts all plug-in circuit boards for the following units:

a. Power supply and regulation.
b. Scanning lockout switches or substitute multiple circuit boards.
c. Level measuring unit.
d. Frequency measuring unit.
e. Noise measuring unit.
f. Calibration standard.

3.02 While the equipment shelf includes no active circuitry, it provides all interconnections for the units listed in Paragraph 3.01. In addition, terminals on the rear of the equipment shelf provide for the following connections:

a. Power input (—48 Vdc or 115 Vac).

b. Signal input (20 tip-ring input channels—ten for level/frequency and ten for noise).

c. Line selection input (for the 20 input channels mentioned above).

d. Level, frequency, and noise measurement BCD-output for up to 10 digital displays.

e. Power output for up to 10 digital displays.

f. Blanking and resolution control for up to 10 digital displays.

g. Busy lamp control for up to 20 lamps or relays.

h. External sample inhibit (three connections; level, noise, and frequency).

i. BCD identification of the input channel selected by level/frequency or noise scanning lockout switch.

j. Test points for monitoring:
   1. Predetected output (PDO).
   2. 1-kHz clock output.
   3. Precision voltages generated by the power supply and regulators.

3.03 As shown on Installation Drawing J1140-002 Sheet 1, the equipment shelf is 14 inches high. Reversible mounting ears provide for mounting in either a 19-inch or 23-inch equipment rack. The locations of all plug-in circuit boards are shown in Drawing J1140-002 Sheet 2. All circuit boards except the power supply are covered by the equipment shelf front cover. The power supply, which is secured by four screws, has its own front cover.

3.04 As shown on Installation Drawing, J1140-002 Sheet 2, the connectors that accept the plug-in circuit boards, as well as the primary interconnection traces, and the input channel connections, are located on the mother board at the rear of the equipment shelf. All connections to the digital displays are by wire-wrap terminals located on the BCD-output circuit board, which is located behind the mother circuit board. Interconnections between these two boards are by ribbon connectors, as shown in Table B on Drawing J1140-002 Sheet 2.

3.05 Both the display connections and the input connections are shown on Drawing J1140-002 Sheet 1, Zone D-5. Display Number 1 is connected to terminal strips TS1F, TS1N, and TS1L. The letters, F, N, and L indicate frequency, noise, and level connections, respectively. Display Number 2 is connected in the same way to the TS2 terminal strips, and so on. Specific BCD-output pin connections are shown in Table C on Drawing J1140-002 Sheet 2.

3.06 Level/frequency input and control connections are made to terminal strips TS11 through TS20 on the mother circuit board. Input channel 1 is connected to TS11, and so on. Noise input and control connections are made in a similar manner to terminal strips TS21 through TS30. Specific input pin connections are shown in Table D on Installation Drawing J1140-002 Sheet 2.

4. POWER SUPPLY AND REGULATION

—48 Vdc POWER SUPPLY

4.01 As shown in Figure 4-1, the power supply receives —48 Vdc and frame ground from

the test center fuse panel. When the power supply is turned to ON, —48 Vdc office battery enters the power supply, is filtered to remove noise that may be present on the battery supply and to prevent any interference generated by the power supply from entering the office battery distribution network. The filtered, but unregulated, —48 Vdc goes to the —43 Vdc regulator, the scanning lockout switches, the common bus terminals on the rear of the equipment shelf and the dc/dc converter.

4.02 The power oscillator in the dc/dc converter receives the —48 Vdc and generates a 5-kHz squarewave which is transformer coupled to the power amplifier. The power amplifier drives the primary winding of a power transformer. Three secondary windings on this transformer develop proper ac voltages which are rectified, filtered, and furnished to the dc regulator circuit boards. These voltages are:

a. +20 Vdc and ground.
b. —20 Vdc and —20 Volt common.
c. +9 Vdc and ground.

4.03 The TTI 1140 contains two identical dc regulator circuit boards. One is for level/frequency functions, and the other is for noise functions. Each dc regulator receives rectified and filtered voltages of +20 Vdc, —20 Vdc, and +9 Vdc from the power supply.

4.04 As shown in Figure 4-3, the level/frequency dc regulator furnishes regulated +15 Vdc, —15 Vdc, and +5 Vdc to the following:

a. Level measuring unit.
b. Calibration Standard.
c. Frequency measuring unit.
d. Level/frequency scanning lockout switch.
e. Level display circuit boards (through the BCD-output circuit board).
f. Frequency display circuit boards (through the BCD-output circuit board).

Figure 4-3 also shows how power is distributed within the TTI 1140.

4.05 As shown in Figure 4-3, the noise dc regulator furnishes regulated +15 Vdc, —15 Vdc, and +5 Vdc to the following:

a. Noise measuring unit.
b. Noise scanning lockout switch.
c. Noise display circuit boards (through the BCD-output circuit board).

115 Vac POWER SUPPLY

4.06 As shown in Figure 4-2, the power supply receives 115 Vac—hot, neutral and ground from the test center fuse panel. When the power switch is turned ON, 115 Vac—hot and ground are applied to the primary of the power transformer. The four secondary windings on the power transformer develop the proper ac voltages which are, with the exception of —48 Vdc, rectified, filtered, and furnished to the dc regulator circuit boards. These voltages are:

a. +20 Vdc and ground.
b. —20 Vdc and —20 Volt common.
c. +9 Vdc and ground.

4.07 Minus 48 Vdc is filtered, regulated, and applied to the digital displays as regulated —43 Vdc. In addition, the filtered, unregulated —48 Vdc is applied to the scanning lockout switches and the common bus terminals at the rear of the equipment shelf.

4.08 As shown in Figure 4-3, the level/frequency dc regulator furnishes regulated +15 Vdc, —15 Vdc, and +5 Vdc to the following:

a. Level measuring unit.
b. Calibration standard.
c. Frequency measuring unit.
d. Level/frequency scanning lockout switch.
e. Level display circuit boards (through the BCD-output circuit board).
f. Frequency display circuit boards (through the BCD-output circuit board).

Figure 4-3 also shows how power is distributed within the TTI 1140.

4.09 As shown in Figure 4-3, the noise dc regulator furnishes regulated +15 Vdc, —15 Vdc, and +5 Vdc to the following:

a. Noise measuring unit.
b. Noise scanning lockout switch.
c. Noise display circuit boards (through BCD-output circuit board).

Test Points on DC Regulators

TEST POINT	VALUE
TP 1	+15 Vdc
TP 2	-15 Vdc
TP 3	+5 Vdc
TP 4	+5 VR

Adjustment on DC Regulators

COMPONENT	ADJUSTMENT OF:
R16	+15 Vdc

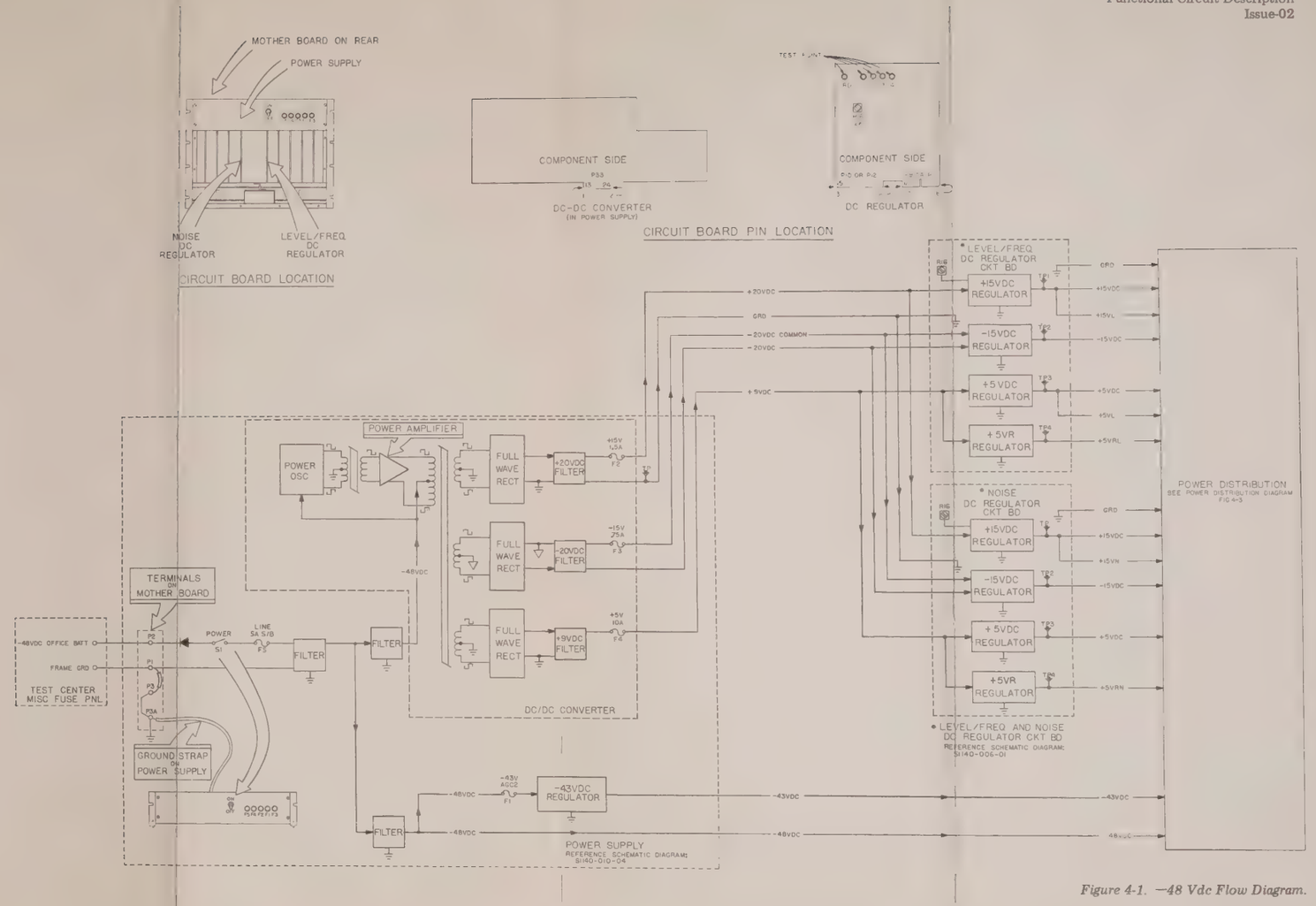


Figure 4-1. −48 Vdc Flow Diagram.

Test Points on DC Regulator

TEST POINT	VALUE
TP 1	+15 Vdc
TP 2	−15 Vdc
TP 3	+5 Vdc
TP 4	+5 VR

Adjustment on DC Regulator

COMPONENT	ADJUSTMENT OF:
R16	+15 Vdc

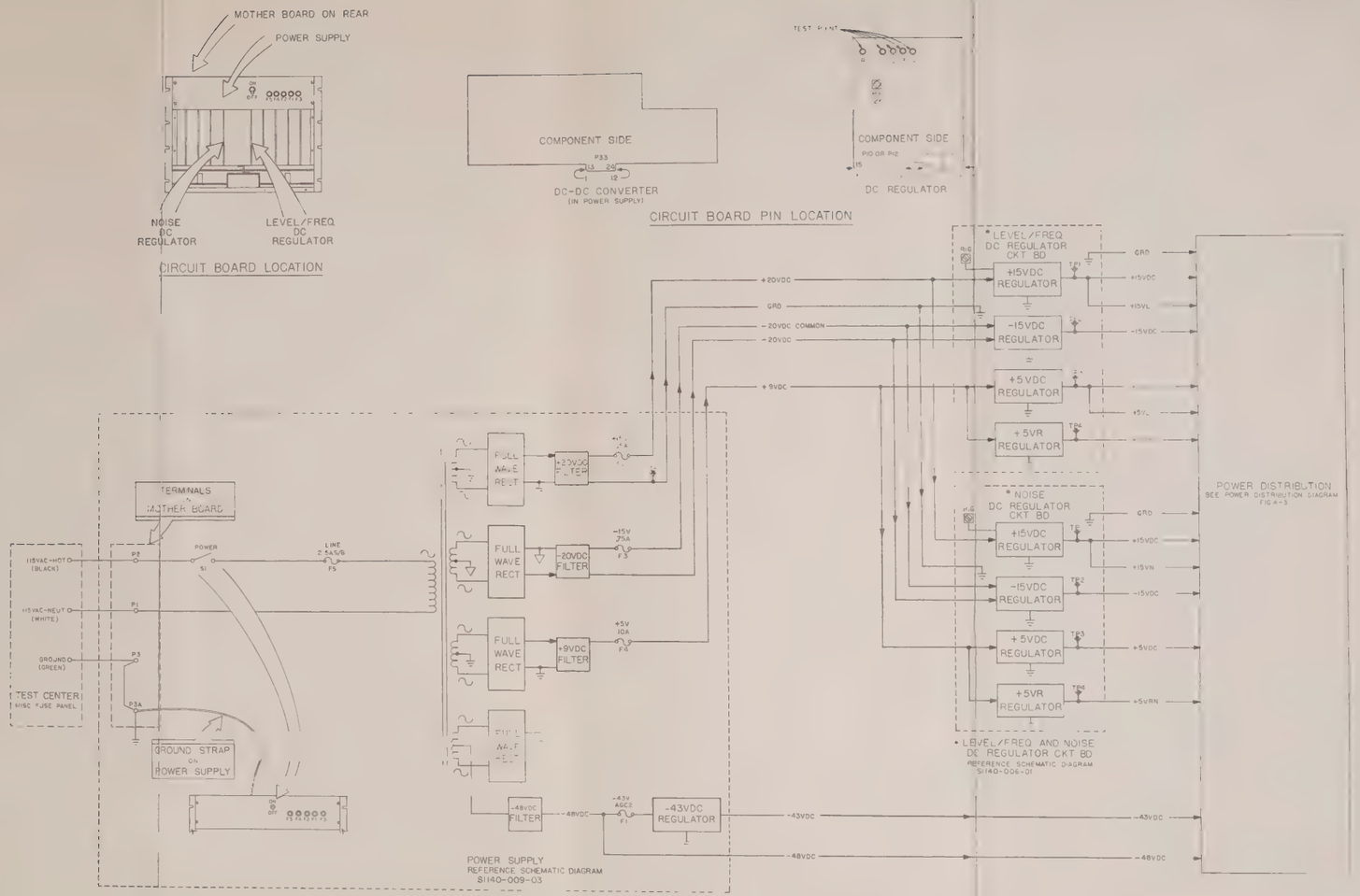


Figure 4-2. 115 Vac Flow Diagram.

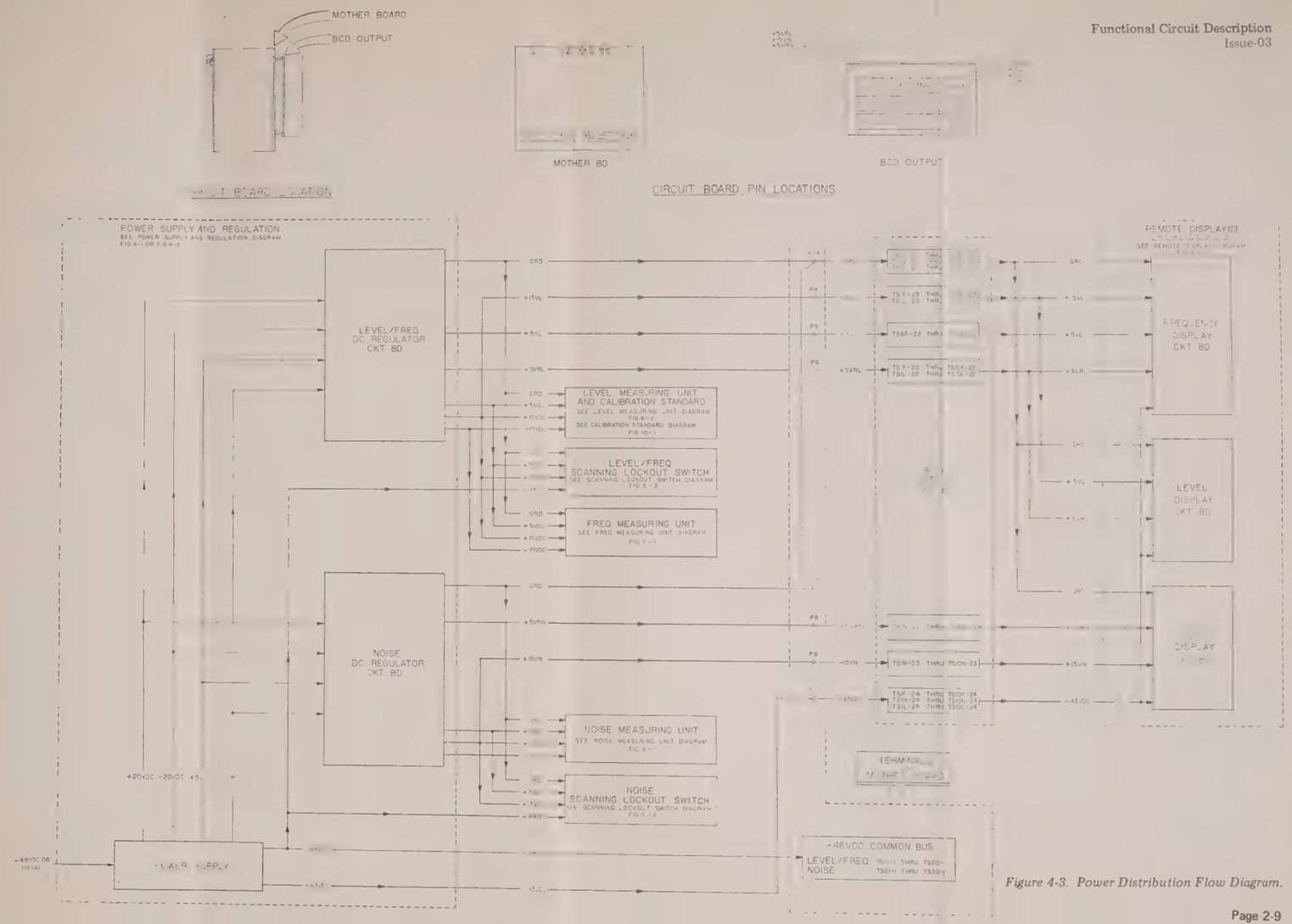

MOTHER BOARD
BCD OUTPUT
MOTHER BD
BCD OUTPUT
CIRCUIT BOARD PIN LOCATIONS
POWER SUPPLY AND REGULATION
SEE POWER SUPPLY AND REGULATION DIAGRAM FIG 4-1 OR FIG 4-2
LEVEL/FREQ DC REGULATOR CKT BD
NOISE DC REGULATOR CKT BD
LEVEL MEASURING UNIT AND CALIBRATION STANDARD
SEE LEVEL MEASURING UNIT DIAGRAM FIG 6-1
SEE CALIBRATION STANDARD DIAGRAM FIG 10-1
LEVEL/FREQ SCANNING LOCKOUT SWITCH
SEE SCANNING LOCKOUT SWITCH DIAGRAM FIG 5-2
FREQ MEASURING UNIT
SEE FREQ MEASURING UNIT DIAGRAM FIG 7-1
NOISE MEASURING UNIT
SEE NOISE MEASURING UNIT DIAGRAM FIG 8-1
NOISE SCANNING LOCKOUT SWITCH
SEE SCANNING LOCKOUT SWITCH DIAGRAM FIG 5-2
REMOTE DISPLAY(S)
SEE REMOTE DISPLAY DIAGRAM FIG 9-1
FREQUENCY DISPLAY CKT BD
LEVEL DISPLAY CKT BD
DISPLAY
-48VDC COMMON BUS
LEVEL/FREQ TS11-1 THRU TS20-1
NOISE TS21-1 THRU TS30-1
+20VDC -20VDC +9.
-48VDC OR +15VAC

Figure 4-3. Power Distribution Flow Diagram.

5. SCANNING LOCKOUT SWITCHES

5.01 The TTI 1140 includes two identical scanning lockout switches, as shown in Figure 5-1. One is for the 10 level/frequency input channels, and the other is for the 10 noise input channels. Each scanning lockout switch, which consists of a line selector circuit board and a strapping circuit board, performs these functions:

a. Continuous sequential scanning of 10 input channels, searching for request for measurement (ground closure).

b. Selection of a specific input channel when a request for measurement is made (through a ground closure at a jack or key access point).

c. Activation of busy lamp indicators at the other nine input channels.

d. Connection of the selected input channel to the appropriate measuring unit, with positive lockout of all other input channels.

e. Control of the following measurement options, depending on how the strapping board is strapped for each of the ten input channels and associated displays:

1. Terminating impedance.
2. Display selective blanking.
3. Noise weighting network selection (noise scanning lockout switch only).
4. Frequency resolution (level/frequency scanning lockout switch only).

f. Visual and external BCD indication of the input channel selected.

5.02 As shown in Figure 5-2, when a measurement is desired, the access position (jack or key) sends a control signal (ground) to the line access control and protection logic. This ground appears on the appropriate input lead to the control logic, and its decimal value is compared to the sequential 1 through 10 binary count generated by the 1-to-10 binary counter. The result is a continuous "scanning" of the input leads. When the channel number and binary count match, the binary counter stops, the selected channel is displayed in the input channel window, and the tip/ring relay corresponding to the selected channel is energized, routing the input signal to the measuring unit. In addition, the ground that energized the tip/ring relay is routed to the strapping circuit board, where it programs the appropriate measuring unit and digital displays in accordance with the strapping options of the selected channel as listed in 5.01(e). This ground is also routed to the busy lamp control logic on the strapping circuit board, which de-energizes the busy lamp for the channel selected and energizes the busy lamps for the nine input channels which are not selected.

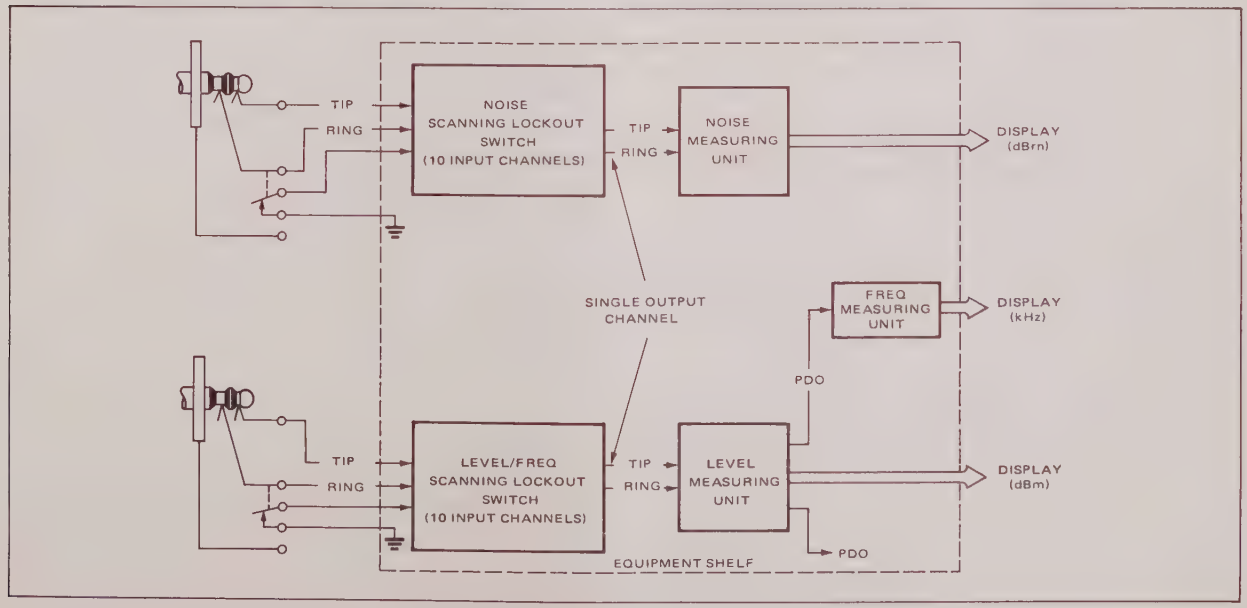
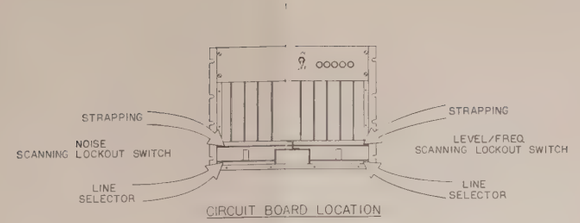
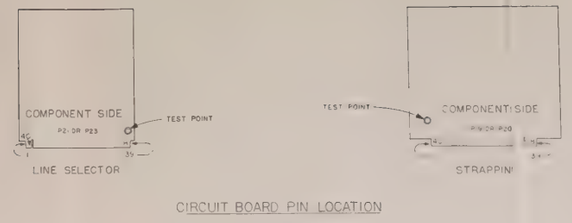


Figure 5-1. Scanning Lockout Switch, Simplified Block Diagram.





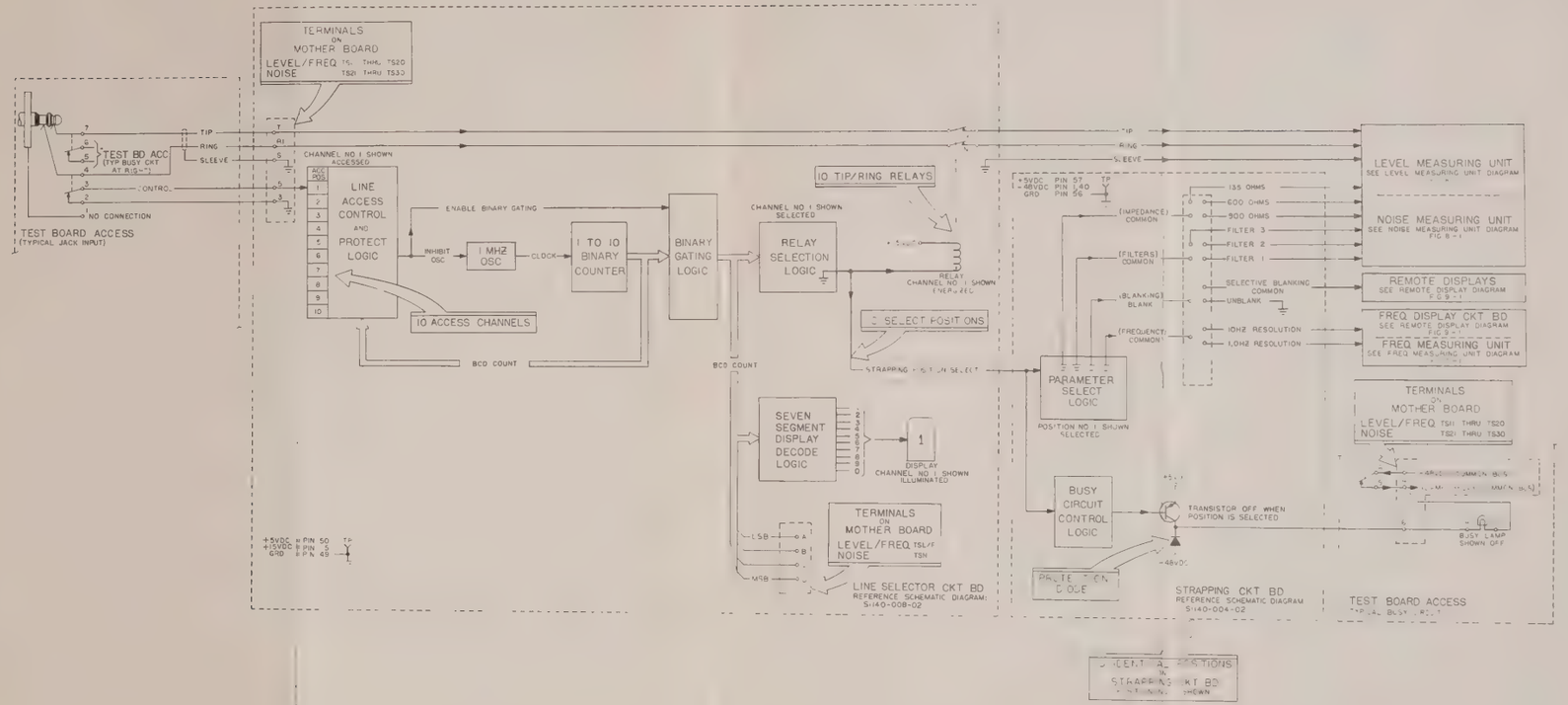


Figure 5-2. Scanning Lockout Switch Flow Diagram.

Level Digital Test Points

TEST POINT	SIGNAL
TP 1	Log Converter
TP 2	60 ms Delay
TP 3	Clock E (62.5 Hz)
TP 4	Pulses (Log Converter Output)
TP 5	Pulses (BCD Counter Input)
TP 6	1 MHz Clock

Level Digital Adjustments

COMPONENT	ADJUSTMENT TO:
C9	1 MHz Crystal Clock Oscillator
R5	Log Converter

Level Analog Test Points

TEST POINT	SIGNAL
TP 1	Analog Input Signal
TP 2	Detector Output
TP 3	−3.162 Vdc Reference
TP 4	−10.000 Vdc Reference
TP 5	Detected Output (V_L)

Level Analog Adjustments

COMPONENT	ADJUSTMENT TO:
R9	Common Mode (level front end)
R41	AC Gain
R49	DC Offset
R69	−10.000 Vdc Reference

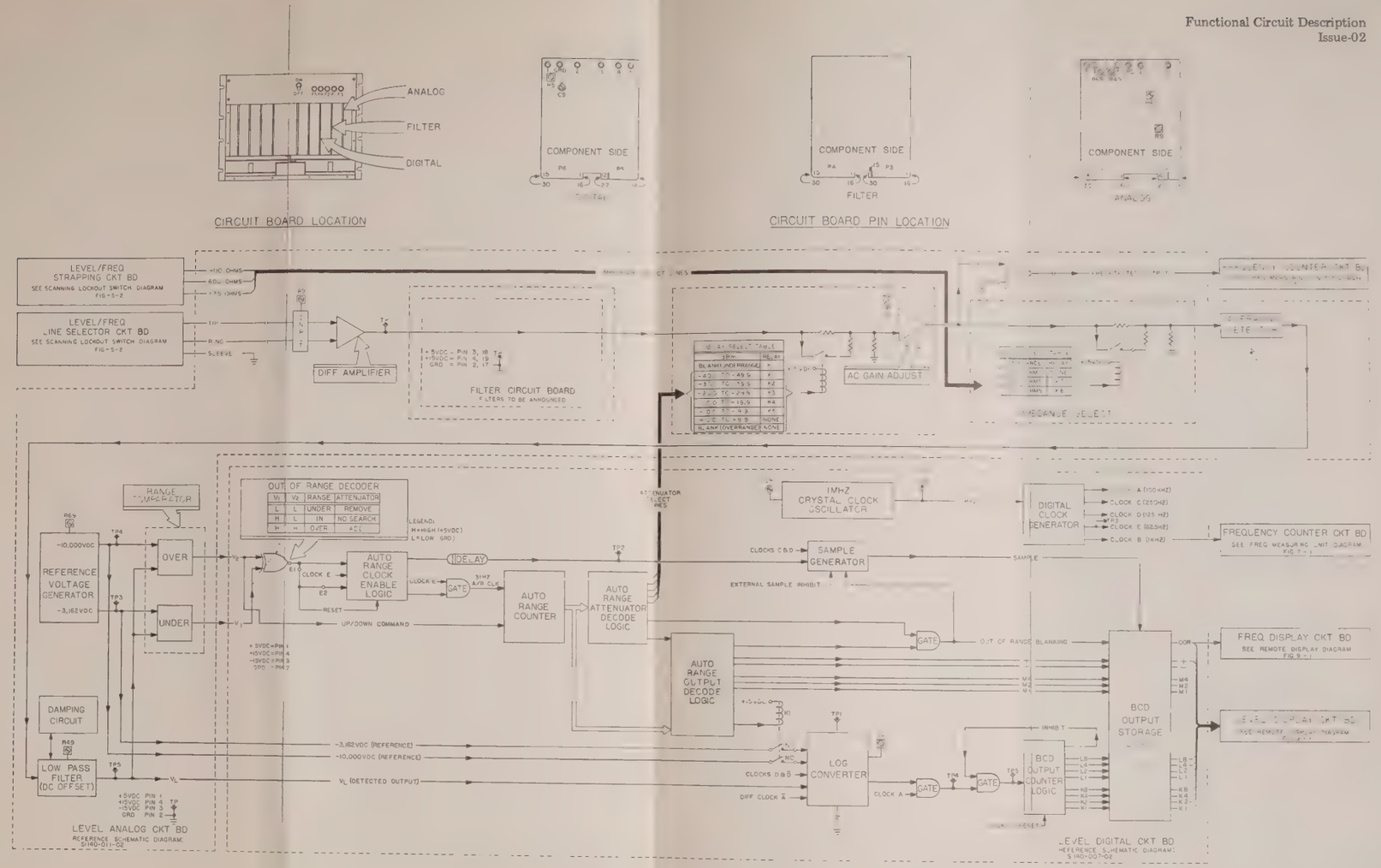


Figure 6-1. Level Measuring Unit Flow Diagram.

7. FREQUENCY MEASURING UNIT

7.01 The frequency measuring unit receives the predetected output (PDO) from the level measuring unit, counts the test signal frequency, and transfers the information to the output storage logic to drive the frequency display circuit boards. The frequency measuring unit receives resolution control (1 Hz or 10 Hz) from the level/frequency strapping circuit board, and a 1-kHz clock signal from the level digital circuit board.

7.02 To achieve a fast counting rate, the applied test signal is effectively multiplied by ten. This higher-frequency signal is then counted, providing a ten-times faster counting rate than would otherwise be possible.

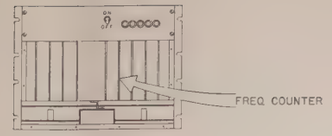
7.03 The predetected output signal from the level analog circuit board is identical to the original input signal applied to the level measuring unit, with one exception: the auto-range circuitry maintains the PDO signal amplitude within a 10-dB level range for an in-range input signal. As shown in Figure 7-1, PDO is applied to the detector and squarewave generator, which generates a squarewave at the PDO frequency. This squarewave triggers the reference one-shot, which in turn provides pulses to the synchronization logic and the reference flip/flop.

7.04 The output from the reference flip/flop goes to the phase detection logic, which, in combination with the error correction logic and the synchronization logic, controls the frequency of the voltage-controlled oscillator (VCO). The VCO operates in phase lock at precisely 10 times the PDO frequency.

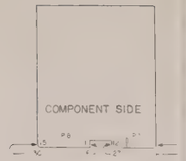
7.05 Pulses from the VCO are sent to the output counter logic through a gate that is held open for a set time period, depending on the resolution selected by the gating logic. The number of pulses passing through the gate in one such gating interval are proportional to the frequency of the PDO signal. The duration of the gating interval determines whether the frequency is measured to 10 Hz or 1 Hz resolution. The selected gate interval for either resolution is derived from the 1-kHz clock signal received from the level digital circuit board. When 10-Hz resolution is selected, the gating interval is 10 milliseconds. When 1-Hz resolution is selected, a gating interval of 100 milliseconds is used. With appropriate reset intervals, this results in 90 frequency updates per second for 10-Hz resolution and 9 updates per second for 1-Hz resolution.

7.06 The units output counter logic receives the gated pulses from the VCO. (When 10-Hz resolution is selected, the units counter becomes the tens counter, and so on.) As the output counter accumulates pulses, one digit is carried to the tens output counter when the count reaches 10. Similarly, when the count in the tens output counter reaches 10, one digit is transferred to the hundreds output counter. And when that count reaches 10, one digit is transferred to the thousands output counter. When the output storage logic receives a sample pulse from the sample one-shot, the contents of all four output counters are transferred in parallel to the output storage logic. The sample one-shot also triggers the reset one-shot, which produces a pulse to reset the output counters for the next count.

7.07 The BCD output storage logic holds the appropriate logic levels on the BCD lines to the frequency display circuit board until it receives an up-dated count from the output counters. If a ground closure is placed on the external sample inhibit control line, no up-dating occurs, and the output storage holds the last count until the ground closure is removed.



CIRCUIT BOARD LOCATION



CIRCUIT BOARD PIN LOCATION

Test Point on Frequency Counter

TEST POINT	VALUE
TP 1	VCO

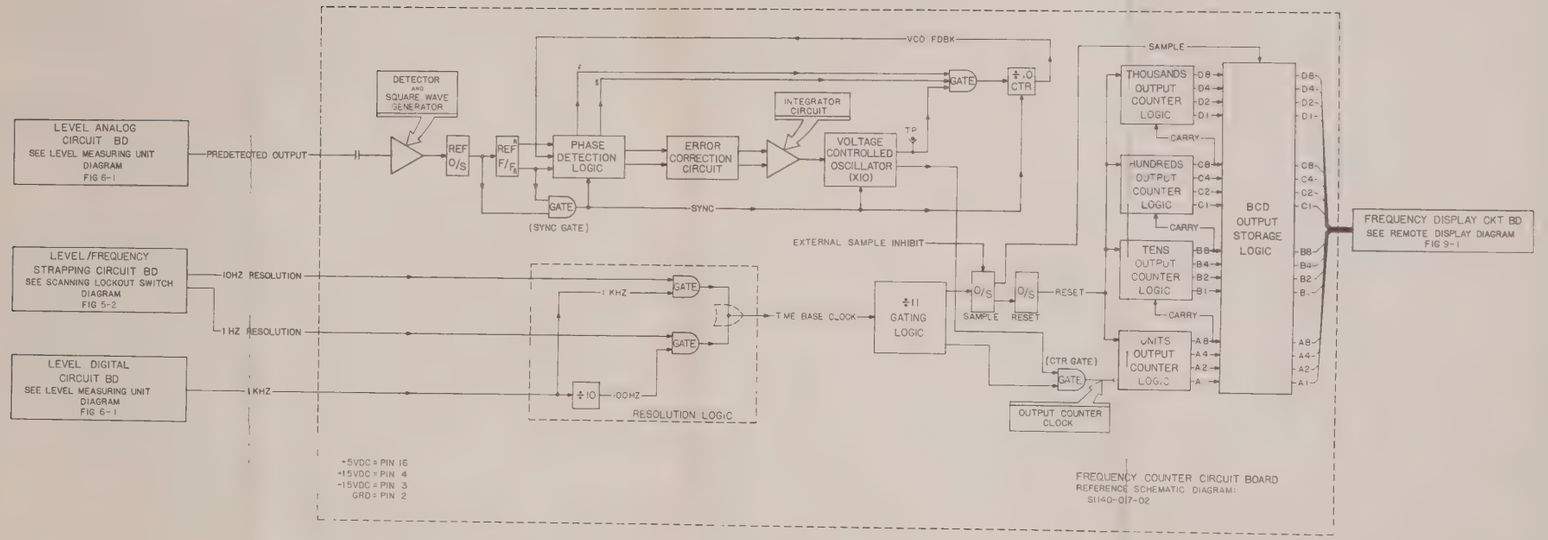


Figure 7-1. Frequency Measuring Unit Flow Diagram.

8. NOISE MEASURING UNIT

8.01 The noise measuring unit consists of the following three printed circuit boards in the equipment shelf:

a. Noise analog.
b. Noise digital.
c. Noise filter.

The basic function of the noise measuring unit is to measure the analog signal from the noise scanning lockout switch and to route the measurement in BCD format to the noise display circuit boards in the digital displays. The noise measuring unit also receives impedance and filter (noise weighting network) selection control from the noise scanning lockout switch. In addition to its BCD output, the noise measuring unit provides out-of-range blanking and plus/minus sign commands to the noise display circuit boards.

8.02 The input circuitry on the noise analog circuit board, which has a bridging impedance greater than 40,000 ohms, provides protection against the following high-voltage conditions:

a. DC—up to ±300 Vdc (Tip to Ring).
b. Polarity—Negative voltage only from Tip or Ring to ground. Nonpolarized Tip to Ring.
c. Spikes—up to 600 volts.
d. Longitudinal voltage—up to 30 Vac rms at 60 Hz.

The input circuitry exhibits longitudinal balance of at least 60 dB at frequencies below 6 kHz. As shown in Figure 8-1 the input circuitry is isolated from the equipment shelf power source and ground bus to prevent any power supply noise from affecting the input signal. From the input protection circuitry, the input signal is fed to a balanced modulator circuit. There it is modulated by a 500-kHz carrier signal. The modulated input is then transformer coupled to a balanced demodulator circuit which also receives the 500-kHz carrier frequency. The demodulation process leaves the original input signal. Any remaining 500-kHz components are removed by passing the demodulated signal through a lowpass filter. (The modulation/demodulation step is employed to achieve high longitudinal balance and high immunity to longitudinal voltages which may be present on the applied test circuit.) The signal is then routed to the appropriate noise weighting network on the noise filter circuit board.

8.03 The filter circuit board incorporates two standard noise weighting networks. They are the C-message (Filter #1) and the 3-kHz flat (Filter #2). One of three optional weighting networks, program, 15-kHz flat or 50 kb/s data is available as Filter #3. The weighting network used for a specific measurement is determined by strapping at the scanning lockout switch (See Paragraph 5). The weighted signal is routed back to the noise analog circuit board, where it is amplified prior to being applied to the auto-ranging attenuator circuitry.

8.04 The auto-ranging attenuators scale the signal to one of six 10-dB ranges. The signal is then fed to an amplifier which introduces a gain of 43 dB. Prior to detection, minor gain compensation is made to correct for the 135-ohm, 600-ohm, or 900-ohm measurement option strapped at the scanning lockout switch.

8.05 The conditioned ac signal is next converted to a proportional dc value by a quasi-rms detector. This dc output is fed to a 50-Hz lowpass filter which removes ripple and introduces a dc gain of ten.

8.06 The detected and filtered output is next applied to a damping circuit. The damping circuit introduces additional filtering to reduce unwanted fluctuations in the noise signal. The damping circuit is controlled by the auto-ranging circuit. While the auto-ranging circuitry operates, the damping is disabled to provide proper detector transient characteristics during the auto-ranging cycle. As soon as auto-ranging is complete, the dc level is again damped and fed to the auto-ranging comparator control circuitry and to the digital log converter.

8.07 The detected output voltage is parallel fed to an over-range comparator and an under-range comparator. The over-range comparator uses a −10.000 Vdc reference voltage, and the under-range comparator uses a −3.162 Vdc reference voltage. When the detected output voltage is not between −3.162 Vdc and −10.000 Vdc, one of the comparators is enabled to command the auto-range circuit to add or remove attenuators as needed. As the input signal comes into range between −3.162 Vdc and −10.000 Vdc, the comparing circuits cause the auto-range circuit to hold the appropriate attenuator. The auto-range circuitry also generates

the tens BCD data for the digital displays, the plus/minus sign control, and the out-of-range blanking command.

8.08 The detected output signal is fed to a digital log converter, along with a —3.162 Vdc reference voltage. The log converter is synchronized by a 200-Hz clock. A capacitor in the log converter is charged to the detected dc value after filtering and damping (V_{LD}), and the serial counter is reset. Commencing with a clock "start" command, the capacitor is then allowed to discharge to the —3.162 Vdc reference voltage. During the discharge period, 10-kHz pulses are gated into, and counted by, the serial counter. When the capacitor has reached the —3.162-Vdc level, the gate is disabled and the count stops. The serial counter receives digital pulses from the log converter gate every 5 milliseconds, regardless of the input signal level.

8.09 During the interval between each log converter counting gate and the next clock pulse, the contents of the serial counter are transferred into the output storage logic. When the output storage logic receives a sample pulse, the count is transferred in parallel to the storage circuits. This count represents the units BCD measurement information. The sample pulse which occurs 200 times per second, also transfers the tens BCD information, plus/minus sign information and out-of-range control to the output storage logic.

8.10 The storage logic maintains a value transferred to it until an update is received. The storage logic is never reset, and its output can only change with a changing input. If a ground closure is placed on the external sample inhibit control line, no updating occurs and the output storage holds the last count until the ground closure is removed. The storage circuit output is fed to the noise display circuit boards in the List 8, 9, 10, and 12 digital displays.

Noise Analog Test Points

TEST POINT	SIGNAL
TP1	Low Pass Filter Output
TP2	dc Gain Amplifier Output
TP3	Quasi Rms Detector
TP4	−3.162 Vdc
TP5	−10.000 Vdc
TP6	Detected Output (V_L)
TP7	500 kHz Carrier
TP8	Demodulator Output
TP9	9V Power Supply Return

Noise Analog Adjustments

COMPONENT	ADJUSTMENT TO:
C62	Noise Front-End
R83	Reference Regulator (−10.000Vdc)
R44	ac Gain
R76	dc Offset

Noise Filter Test Points

TEST POINT	SIGNAL
TP1	Filter Input Bus
TP2	Filter #1 Output
TP3	Filter #2 Output
TP4	Filter #3 Output
TP5	Filter Output Bus

Noise Filter Adjustments

COMPONENT	ADJUSTMENT TO:
R1	Filter #1
R2	Filter #2
R3	Filter #3

Noise Digital Test Points

TEST POINT	SIGNAL
TP1	Log Converter
TP2	1 MHz Clock
TP3	Clock C (200 Hz)
TP4	Gated Clock $\overline{A}$ (10 kHz)
TP5	BCD Output Counter
	Clock (Gated Clock $\overline{H}$)

Noise Digital Adjustments

COMPONENT	ADJUSTMENT TO:
C2	1 MHz Clock
R15	Log Converter

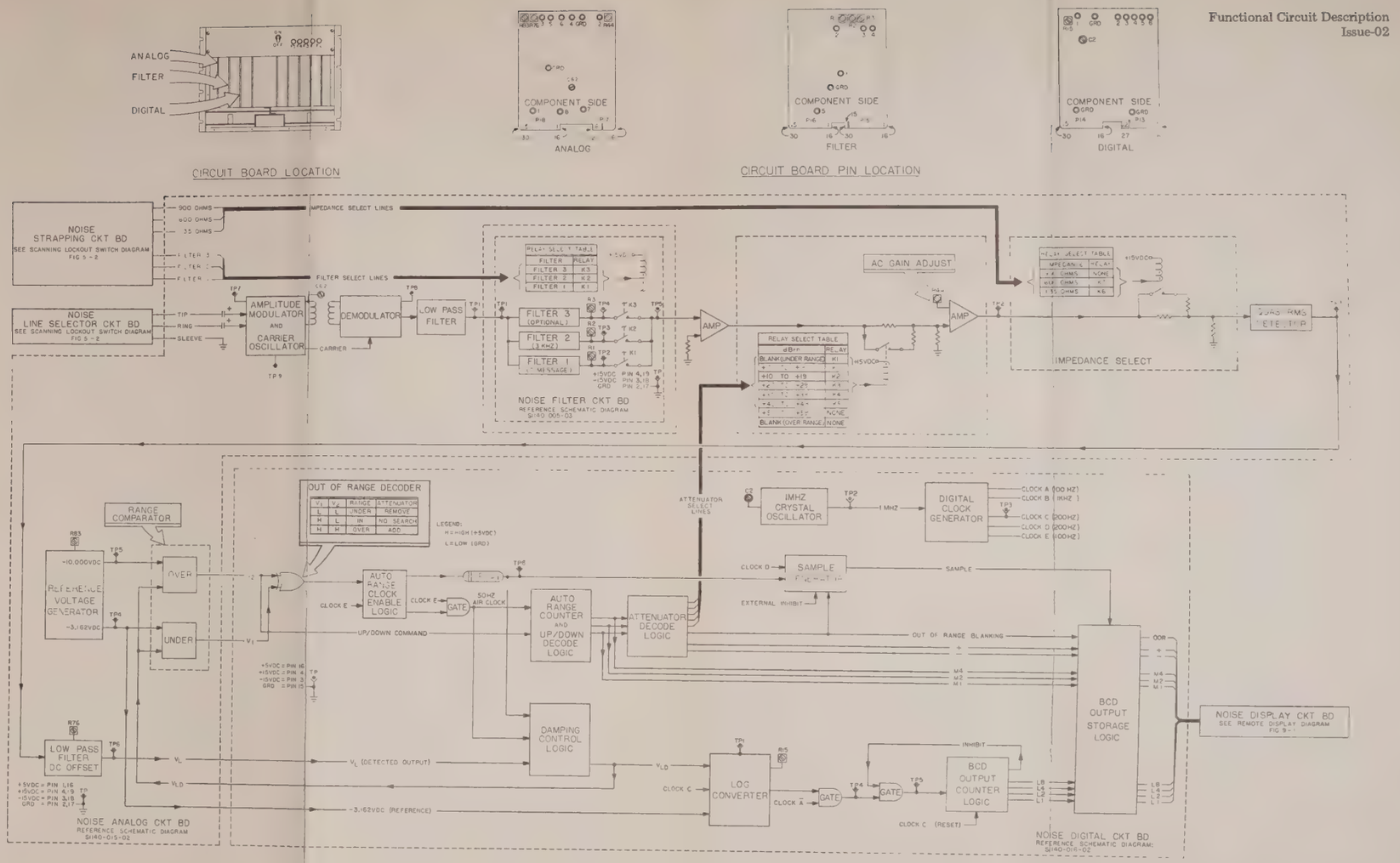


Figure 8-1. Noise Measuring Unit Flow Diagram.

9. DIGITAL DISPLAYS

9.01 The four types of digital displays, TTI 1140A-2 List 8,9,10,12 and 13 are functionally and electrically identical. Since they differ only in form and size, the following description applies to all four.

9.02 Each digital display housing, if so equipped, contains the following three circuit boards:

a. Frequency display.
b. Noise display.
c. Level display.

The List 8,10,12 and 13 housings include mounting hardware and the wire-wrap terminals for connection to the equipment shelf BCD-outputs. The list 9 display housing includes wire-wrap terminals for connection to the equipment shelf BCD-outputs.

9.03 Each of the three display circuit boards contains its own dc/dc converter. This converter receives regulated —43 Vdc from the power supply in the equipment shelf, and generates +200 Vdc for use as the Nixie tube supply voltage.

FREQUENCY DISPLAY CIRCUIT BOARD

9.04 As shown in Figure 9-1, the frequency display circuit board consists of four Nixie tubes and two light-emitting diodes. Frequency measurements from 60-Hz to 60-kHz may be displayed directly to a resolution of 10-Hz. Frequency measurements from 100-Hz to 9.999-kHz, and the last four digits of measurements between 10-kHz and 60-kHz, may be displayed directly to a resolution of 1-Hz. The desired resolution is selected by strapping at the level/frequency scanning lockout switch. This strapping controls the appropriate light-emitting diode to act as the decimal point.

9.05 In addition to its power input, the frequency display circuit board receives a parallel BCD signal from the frequency counter circuit board, resolution control and selective blanking control from the level/frequency strapping circuit board, and out-of-range blanking control from the level digital circuit board. The BCD input, which contains the primary frequency measurement information, is applied to four decode logic circuits. These are designated thousands, hundreds, tens, and units decode logic, and they function in that capacity when 1-Hz resolution is selected. When 10-Hz resolution is selected, these circuits become the ten thousands, thousands, hundreds, and tens decode logic.

NOISE DISPLAY CIRCUIT BOARD

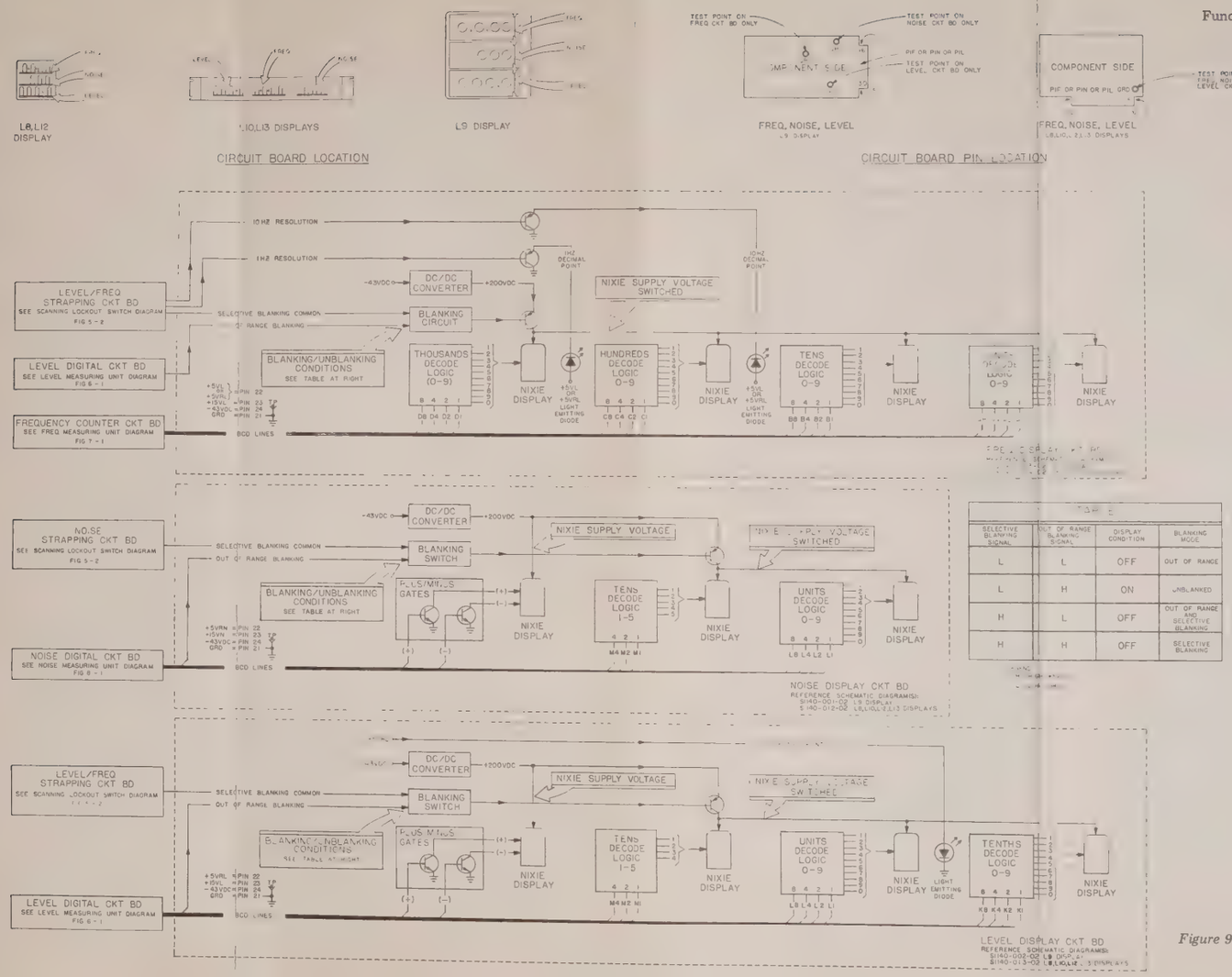
9.06 As shown in Figure 9-1, the noise display circuit board consists of three Nixie tubes (two digits and a plus/minus sign). Measurements from +1 to +59 dBrn are displayed to a resolution of 1 dB. The two-digit display blanks at 0 dBrn (minus sign comes on) and at 60 dBrn (plus sign stays on).

9.07 In addition to its power input, the noise display circuit board receives a parallel BCD signal, out-of-range blanking control, and plus/minus control from the noise digital circuit board, and selective blanking control from the noise strapping circuit board. The BCD input, which contains the primary noise measurement information, is applied to the tens decode logic and the units decode logic to drive the two-digit Nixie display. The plus/minus control drives the third Nixie tube, illuminating the plus or minus sign as appropriate. Both the out-of-range and selective blanking controls are fed to the blanking switch to blank the two-digit display under appropriate circumstances.

LEVEL DISPLAY CIRCUIT BOARD

9.08 As shown in Figure 9-1, the level display circuit board consists of four Nixie tubes (three digits and a plus/minus sign) and a light-emitting diode to act as a decimal point. Level measurements are displayed directly in dBm to a resolution of 0.1 dB over the range from —49.9 to +9.9 dBm. The display blanks at —50 dBm (minus sign stays on) and at +10 dBm (plus sign stays on).

9.09 In addition to its power input, the level display circuit board receives a parallel BCD signal, out-of-range blanking control, and plus/minus control from the level digital circuit board. Selective blanking control is received from the level/frequency strapping circuit board. The BCD input is applied to the tens, units, and tenths decode logic to drive the three-digit Nixie display. The plus/minus control drives the fourth Nixie tube, illuminating the plus or minus sign as appropriate. Both the out-of-range and the selective blanking controls are fed to the blanking switch to blank the three-digit display under appropriate circumstances.



SELECTIVE BLANKING SIGNAL	OUT OF RANGE BLANKING SIGNAL	DISPLAY CONDITION	BLANKING MODE
L	L	OFF	OUT OF RANGE
L	H	ON	UNBLANKED
H	L	OFF	OUT OF RANGE AND SELECTIVE BLANKING
H	H	OFF	SELECTIVE BLANKING

Figure 9-1. Display Flow Diagram.

10. CALIBRATION STANDARD

10.01 The calibration standard generates two outputs that are precise in level and frequency. As long as the calibration standard is in the equipment shelf and power is applied, the circuit board supplies 0.0 dBm at 1 kHz to the level/frequency input channel—10 terminals, T10 and R10, at the rear of the equipment shelf. The circuit board also supplies the noise input channel—10 terminals, T10 and R10, with a +45 dBrn signal at 1 kHz.

10.02 When the calibrate key is depressed, and level/frequency input channel—10 and noise input channel—10 are selected by their respective scanning lockout switches, the calibration standard outputs are routed to the respective measuring units in the same manner as an input signal.

10.03 As shown in Figure 10-1, a 1-MHz crystal oscillator on the calibration standard circuit board generates a 1-MHz squarewave which is divided by one thousand before application to a buffer amplifier. The resultant 1-kHz signal is filtered and applied to an automatic gain control circuit (AGC), which provides the necessary output signal level stability. The AGC circuit output is applied to the output amplifier which amplifies the 1-kHz signal to 0.0 dBm for the level and frequency measuring units. This signal is attenuated to produce a 1-kHz signal at +45 dBrn for the noise measuring unit.

Test Points

TEST POINT	SIGNAL
TP1	1-MHz Clock
TP2	Filter Output
TP3	AGC Amp Output
TP4	+15 Vdc
TP5	0 dBm, 1-kHz
TP6	45 dBrn, 1-kHz

Adjustments

COMPONENT	ADJUSTMENT OF:
R25	AGC Control
C2	1-MHz Clock
R21	Output Amplitude
R38	Filter Output

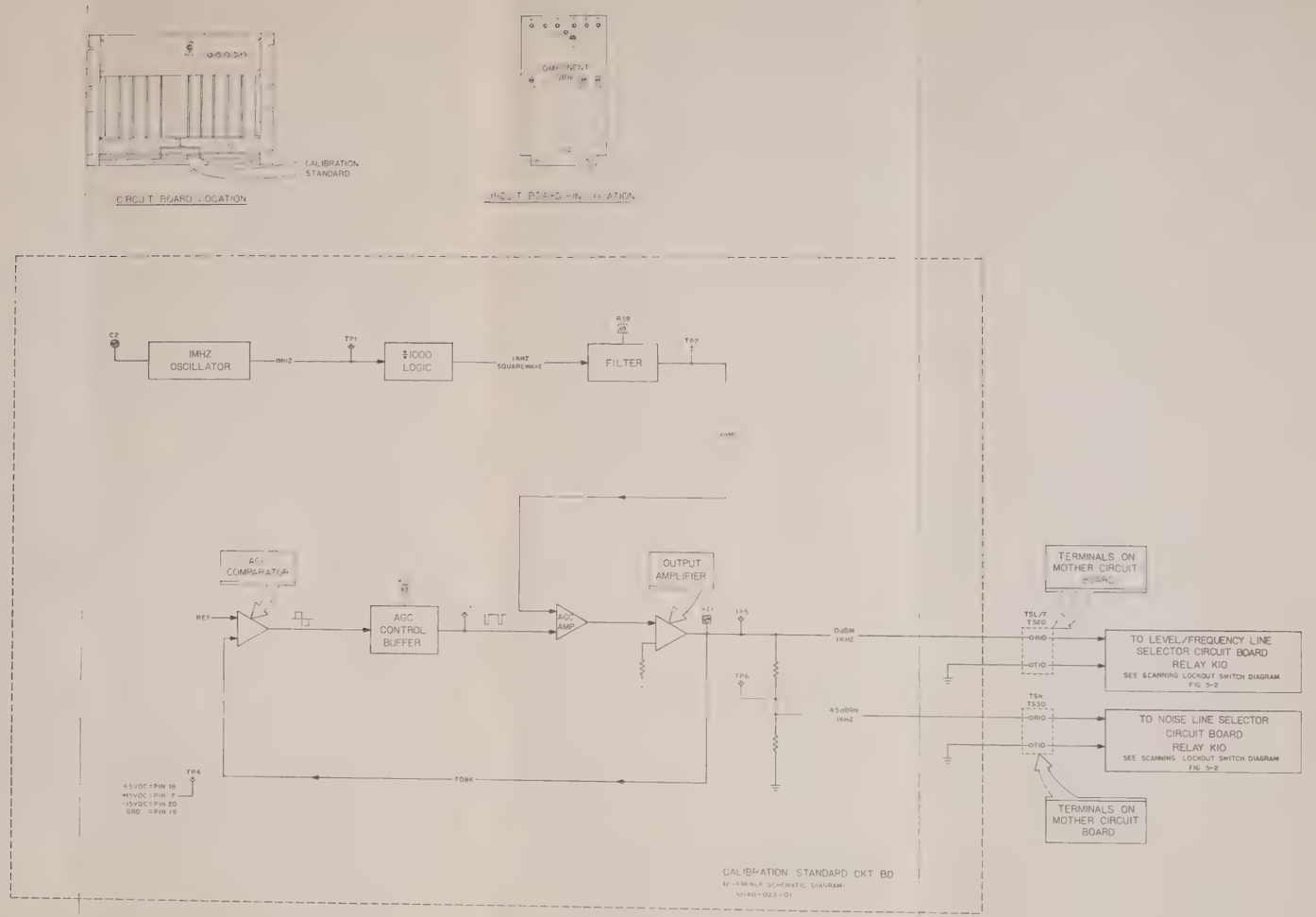


Figure 10-1. Calibration Standard Flow Diagram.

SECTION 3
TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM (UTMS)
TROUBLE LOCATING

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1. GENERAL

1.01 This section contains trouble locating and repair information for the TTI 1140 UTMS. The main paragraphs contained in this section are:

a. Preliminary Checks, Paragraph 2.

b. Trouble locating during equipment installation, Paragraph 3.

c. Trouble locating during equipment operation, Paragraph 4.

FACTORY MAINTENANCE AND REPAIR

1.02 Maintenance and repair of the TTI 1140 is done on a circuit board– change basis. All trouble shooting and repair of circuit boards must be done by TTI or an authorized representative. Any attempt to repair or modify TTI 1140 UTMS circuit board(s), without authorization from TTI, voids the equipment warranty.

1.03 If a malfunction cannot be resolved by the trouble locating procedures in this section, call TTI Field Service at (408) 735-8080. A telephone consultation can sometimes resolve an apparent problem without the need to change any circuit boards.

1.04 If the telephone consultation indicates the need for repairs, TTI will authorize the return of the affected circuit boards for repair. If time is critical, TTI can arrange to ship replacement circuit boards immediately. In any case, the defective circuit boards must be carefully packed and returned to TTI by the fastest shipping method. Address package to:

Telecommunications Technology, Inc.
555 Del Rey
Sunnyvale, California 94086

REPAIR CHARGES

1.05 If the equipment is on warranty, and the necessary repairs are covered by the warranty, located on the inside of the rear cover of this manual, the customer's only responsibility is to pay the shipping costs to return the affected circuit boards. TTI will repair the circuit boards at no charge and will pay one-way return shipping charges.

1.06 If the equipment is not under warranty, or if the necessary repairs are not covered by the warranty, TTI will make a reasonable charge for the repair and will bill the customer for return shipping charges.

TROUBLESHOOTING GUIDELINES

1.07 Before performing maintenance of any kind, approach the malfunction with an overall visual check of the TTI 1140 UTMS. Look for the following:

a. Common indications.
b. Fault patterns.

When troubleshooting is performed, the only test equipment required is a multi-meter to measure voltages and check for wiring continuity.

Common Indications

1.08 Common indications are malfunctions that are indicated at all digital displays. An example follows. Suppose display No. 1 fails to show a frequency reading or shows an erroneous frequency reading. Several questions immediately arise. The first is whether all displays show the same problem. If any display shows a correct reading, the problem is not in the common circuitry, such as the frequency measuring unit. However, since all frequency displays are connected in parallel to the equipment shelf, one bad display could be causing all displays to fail. This can be checked by removing all frequency display circuit boards and reinserting them one at a time. If each display individually shows the same problem, the common circuitry is suspect. This includes all wiring between the equipment shelf and frequency display(s), the frequency ribbon connector, and the frequency measuring unit.

1.09 Since the frequency measuring unit receives its input from the level measuring unit, the analog circuit board in the level measuring unit might also be the cause of the problem. If the frequency display problem is associated with a level display problem, the level measuring unit and its associated wiring is highly suspect. The Functional Circuit Description in Section 2 of this manual (and the flow diagrams, in particular) should be an invaluable aid in interpreting trouble symptoms along the lines discussed above.

Fault Patterns

1.10 Fault patterns may or may not be common indications. However, they do help in isolating the source of the malfunction. An example of the fault pattern of a malfunction follows. Suppose display No. 1 indicates an error in the frequency reading. That is, only positive numbers are displayed by the units Nixie display. To resolve this malfunction, refer to Table 4-1 in Section 4 of this manual. Pins 13 through 16 are the BCD lines connected to the units digit. Pin 16 is the least significant bit (LSB), or 1-bit. If the 1-bit is never activated, the units decode logic in the display will never see an odd number, since the 1-bit determines whether the displayed number is even or odd. Therefore, the units Nixie tube will never display an odd number such as 1, 3, 5, 7, and 9.

1.11 A further investigation should determine whether the malfunction is common as discussed in Paragraph 1.09 of this section. If the fault is only occurring at one display, the BCD wiring to that display circuit board should be checked. If the problem is not in the wiring, the faulty display circuit board should be replaced.

NOTE

An investigation should always be made to ensure that the trouble and/or cause is not being caused by external factors such as high temperature, radiated fields, moisture, etc. There are a number of malfunctions that can be directly related to the effects of external equipment on digital circuitry. Take time and be certain before proceeding with the documented repair information in this section. It may save repair time.

2. PRELIMINARY CHECKS

2.01 Preliminary checks should be accomplished when failures occur during equipment installation and during normal equipment operation.

CAUTION

Turn the UTMS power switch to OFF before removing or replacing any circuit boards or fuses and before checking any wiring. Be particularly careful not to insert circuit boards in the wrong slots.

a. Check all fuses on the UTMS front panel.

b. Ensure that the UTMS is receiving appropriate power (—48 Vdc or 115 Vac, depending on the power supply) and proper grounding.

c. Ensure that the following voltages are present at both dc regulators:

1. +5 Vdc ±0.25 Volts (two test points per regulator).
2. +15 Vdc ±0.25 Volts.
3. —15 Vdc ±1.0 Volt.

d. Ensure that the following voltages are present:

1. —43 Vdc (See Figures 4-1, 4-2 and 4-3 in Section 4 of this manual for location).

2. —48 Vdc (See Figure 4-4 in Section 4 of this manual for location).

e. Ensure that all circuit boards are properly seated (remove, clean connectors, and reseat).

NOTE

The connector pins on the circuit boards may pick up a residue that can cause high resistance. A fine, non-metallic abrasive such as a pencil eraser may be used to clean the connectors.

f. Ensure that the UTMS is receiving the correct input from external equipment.

g. Ensure that all input channel and BCD-output cables are properly connected.

h. Check the quality of all wire wrap and solder connections.

i. Ensure that all ground paths are connected and that no ground loops exist (specifically check the shield of each input cable; these should be grounded only at the equipment shelf).

j. Ensure that each strapping board is correctly strapped.

k. Examine circuit boards for loose, burned or damaged components.

3. TROUBLE LOCATING DURING INSTALLATION

3.01 Most equipment malfunctions during installation result from wiring errors—shorts, opens, miswiring, etc. While some types of wiring errors do not cause equipment damage, other types do cause damage. Therefore, if a defective circuit board is located, all associated wiring must be checked for faults before a new circuit board is installed.

3.02 These procedures list "symptoms," "probable causes," and "checks and remedies" for the malfunctions that are most likely to be encountered. The procedures cover three general classes of malfunction symptoms listed below in the order of the likelihood of their occurrence:

a. Fuses blow at the equipment shelf and/or at the office fuse panel.

b. Busy lamps and/or line selectors operate improperly. This includes busy lamps and relays (if used), interface wiring, and the line selector position indicators at the equipment shelf.

c. The displays provide no readout or an improper readout.

FUSE BLOWING

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
TTI 1140 fails to energize.	a. Bad line fuse at equipment shelf (F5) or at office fuse panel.	a. Replace line fuse (F5) at the equipment shelf front panel or at office fuse panel.
	b. Improper wiring at the equipment shelf power input terminals.	b. Ensure that the input power wires are properly connected to the power input terminals P1, P2 and P3 at the equipment shelf.
TTI 1140 operates erratically.	Constant or intermittent open in one or more power supply or dc regulator voltages.	Check all fuses at the equipment shelf front panel (replace where bad). Remove power supply, clean circuit board connector pins and reinstall supply, ensuring good contact of all pins. (Reinstall ground strap). Remove both dc regulator circuit boards. Clean pins and reinstall, ensuring circuit boards are bolted in. Replace power supply and/or dc regulator circuit boards, if the problem still exists.
Office fuse blows when equipment shelf is energized.	a. Short in input channel wiring.	a. With an ohmmeter check from terminal 1 to terminals 3 and 4 of ALL input channels (TS11—TS30). If a short exists, isolate and remove it.
	b. Wrong fuse at office fuse panel.	b. Ensure that the proper line fuse is installed.
Office fuse blows after the equipment shelf has been energized for a short period.	Incorrect busy lamp or controlling relay in busy lamp circuit.	Ensure that busy lamps or controlling relay(s) are —48 Vdc type. Lamp(s), 48C or equivalent; relay AK4 or equivalent.

BUSY-LAMP CIRCUIT AND LINE SELECTOR FAILURES

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
Busy lamp fails to extinguish when corresponding position is accessed.	a. Normal indication if scanning lockout switch is not used.	a. Normal operation.
NOTE 1 In probable causes (b, c, & d), the line selector channel display at the equipment shelf should indicate that affected position. Use this aid to isolate the problem.	b. Another access plug has been left "jacked in".	b. Remove all plugs except at position under test.
	c. Jack contacts and/or input terminals shorted together.	c. With an ohmmeter, check continuity between terminals 5 and 3 of ALL input channels (TS11 through TS30) WITH ALL ACCESS PLUGS REMOVED. If a short exists, isolate and remove it.
NOTE 2 If step (f) is performed, ensure that the strapping configuration is transferred to the replacement circuit board.	d. Terminal 6 of affected input channel only shorted to ground or to some positive voltage.	d. With an ohmmeter, check for continuity between terminal 6 and terminal 3 (GRD) of the affected channel only, or between terminal 6 and all voltage fuses. If a short exists, isolate and remove it.
	e. Line selector circuit board.	e. Replace line selector circuit board.
	f. Strapping circuit board.	f. Replace strapping circuit board.
Busy lamps fail to illuminate (one or more positions ARE accessed).	a. Busy lamps NOT installed.	a. Install busy lamps.
	b. Defective or wrong lamp(s) or controlling relay(s) in busy lamp circuit.	b. Ensure that the busy lamps or controlling relays are —48 Vdc type. Lamp 48C or equivalent; relay AK4 or equivalent.
NOTE If step (f) is performed, ensure that the strapping configuration is transferred to the replacement circuit board.	c. Busy lamp/relay wiring is not correct.	c. Ensure that terminals 4 and 6 of ALL positions used are correctly wired. Terminal 4 is —48 Vdc; terminal 6 is return to +5 Vdc.

BUSY-LAMP CIRCUIT AND LINE SELECTOR FAILURES (Continued)

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
	d. Busy lamp interface unit (i.e., relay panel) wiring is not correct.	d. Ensure that input channel terminals 4 and 6 of all channels used are correctly wired to the interface unit. Ensure that the interface unit is properly activating.
	e. Blown fuse at interface unit (i.e., relay panel).	e. Replace interface unit fuse.
	f. Strapping circuit board.	f. Replace strapping circuit board.
	g. Line selector circuit board.	g. Replace line selector circuit board.
No number appears at the equipment shelf INPUT CHANNEL window (at least one channel has been accessed and a measurement is being made).	a. Normal indication if scanning lockout switch is not used.	a. Normal operation.
	b. Line selector circuit board.	b. Replace line selector circuit board.
Wrong number appears at the equipment shelf INPUT CHANNEL window. **NOTE** For correct operation, terminal 5 of ALL input channels is open when no channels are being accessed. When a channel is accessed, terminal 5 of that input channel is switched to ground by the external jack.	a. Wrong jack is being accessed.	a. Ensure that the proper jack is being accessed.
	b. Input channel wiring incorrect at equipment shelf or at external interface.	b. With an ohmmeter, check continuity between terminals 3 and 5 of ALL input channels (TS11—TS30). If continuity exists at other than the one being accessed, isolate the short and remove it.

DIGITAL DISPLAY READING(S) ARE IN ERROR

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
One or more level and/or noise displays indicates a constant 1.8 dB error.	Improper termination impedance strapping. Terminating resistor is 600 ohms; strapping circuit board is strapped for 900 ohms, or vice versa.	At strapping circuit board correct strapping for positions indicating this error.
One or more level and/or noise displays indicates a constant 3 dB error.	Two terminating resistors have been connected in parallel (double termination).	Remove one of the terminating resistors. Ensure that the strapping circuit board and the terminating resistor are matched. If inputs are multipled, ensure that the terminating resistor is connected to the most remote jack in the line-up.
One or more level and/or noise displays indicates a constant +6 dB error.	No terminating resistor connected at access jack.	Ensure that a terminating resistor is connected across the tip/ring contacts of the jack. If inputs are multipled, ensure that the terminating resistor is connected to the most remote jack in the line-up. The strapping circuit board impedance strapping must coincide with the value used.
One or more level and/or noise displays indicates a constant 6.4 dB error.	Improper terminating impedance strapping. Terminating resistor is 600 ohms; strapping circuit board is strapped for 135 ohms, or vice versa.	At strapping circuit board, correct strapping for positions indicating this error.

DIGITAL DISPLAY READING(S) ARE IN ERROR (Continued)

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
Frequency reading is off by a factor of ten.	Improper strapping on level/frequency strapping circuit board.	At the strapping circuit board, ensure that the common terminal is strapped to 1.0-Hz terminal for 1 Hz resolution, or that the common terminal is strapped to 10-Hz terminal for 10-Hz resolution at each position used.
Frequency measurement is random or "frozen" at one or more frequency displays. Decimal point is NOT present.	Resolution strapping missing on level/frequency strapping circuit board.	At the strapping circuit board, ensure that the common terminal is strapped to 1.0-Hz terminal for 1-Hz resolution, or that the common terminal is strapped to 10-Hz terminal for 10-Hz resolution at each position used.
Frequency measurement is "frozen" from one or more access positions. **NOTE** If step C is performed, ensure that strapping configuration is transferred to the replacement circuit board.	a. No resolution strapping. b. Short in resolution wiring. c. Level/frequency strapping circuit board.	a. Ensure that proper resolution strapping exists for the affected channels at the level/frequency strapping circuit board. b. At the level/frequency strapping circuit board, make continuity check between 10-Hz and 1-Hz terminals. Continuity should not exist. If a short exists, isolate and remove it. c. Replace the level/frequency strapping circuit board.
Erroneous reading at one or more noise displays.	Wrong filter strapped on noise strapping circuit board.	Strap the affected channels on the noise strapping circuit board for the correct weighting network (filter).
No noise measurement at one or more displays.	No noise filter strapped on strapping circuit board.	Strap the affected channels on the noise strapping circuit board for the correct weighting networks (filters).
Position is accessed but no measurement is made. (The line selector display at the equipment shelf indicates a channel has been accessed.)	a. No input signal. b. Line selector circuit board.	a. Check signal input wiring. Clean tip/ring contacts at access jacks. b. Replace the line selector circuit board.
Random measurement appears on remote display. (No position has been accessed.)	Line selector circuit board.	Replace the line selector circuit board.
All displays are blanked. (Decimal points may or may not be illuminated.)	a. No input signal. b. −43 Vdc fuse. c. Ribbon connectors are not connected. d. DC regulator(s). e. Power supply.	a. Ensure that input wing is correct. Ensure that jacks and plugs are making good contact. b. Replace −43 Vdc fuse (F1) at equipment shelf front panel with AGC2 or equivalent 2 amp slow-blow. c. Ensure that ribbon connectors between mother circuit board and BCD-output circuit board are connected. d. Replace dc regulator circuit board(s). e. Replace power supply.
All displays fail to illuminate or are "frozen" at some random value.	Blown fuse(s) at equipment shelf.	Ensure that all fuses at the equipment shelf front panel are good.
All readouts in a single display housing are blanked.	Defective −43 Vdc fuse (F1) in display housing.	Replace display housing fuse with AGC 1/4 amp or equivalent.
Display is blanked but should NOT BE. (At least one other display indicates properly.)	a. Improper strapping on level/frequency strapping circuit board.	a. At strapping circuit board ensure that straps for display positions operating unblanked are connected between the unblanked terminal (GRD) and the common terminal.

DIGITAL DISPLAY READING(S) ARE IN ERROR (Continued)

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
	b. Reversal or short in display wiring.	b. Check BCD-output wiring at equipment shelf and at the remote display. Ensure that terminal 17 at BCD-output and pin 17 of the display connector are not shorted to ground.
	c. Display circuit board.	c. Replace the display circuit board.
Display is not blanked but should be. (At least one other display reads properly.)	a. Improper strapping on strapping circuit board.	a. At strapping circuit board, ensure that straps for display positions operating blanked are connected between the blank terminal and the common terminal.
	b. Reversal or short in display wiring.	b. Check BCD-output wiring at the equipment shelf and at the remote display. Ensure that terminal 20 at BCD-output and pin 20 of the display connector are not shorted to ground.
One or more digital displays almost always indicates a readout error.	a. BCD-output display input wiring in error.	a. Ensure that ALL wires are properly connected between the BCD-output position and the corresponding display connector.
	b. Display circuit board.	b. Replace display circuit board.

4. TROUBLE LOCATING DURING EQUIPMENT OPERATION

4.01 If malfunctions should occur during equipment operation, the trouble locating steps contained in this paragraph will assist in isolating the fault.

4.02 The trouble locating steps contained in this paragraph are divided into four parts. Each of these parts represents a complete operating unit within the TTI 1140. These units are:

a. Power supply and dc regulation.

b. Level measuring circuitry (including ALL level displays, BCD wiring, the level/frequency scanning lockout switch and calibration standard).

c. Frequency measuring circuitry (including ALL frequency displays, BCD wiring, and calibration standard).

d. Noise measuring circuitry (including ALL noise displays, BCD wiring, noise scanning lockout switch, and calibration standard).

By first isolating a problem to one of these operating units, it becomes much easier to locate a specific malfunction. Since the digital displays almost always indicate malfunctions that occur in the TTI 1140, most of the symptoms in this paragraph start at the digital displays.

4.03 This Paragraph includes NO installation trouble locating steps and assumes that the TTI 1140 has been performing to specifications.

NOTE

Before proceeding with these trouble locating steps, perform the Preliminary Checks in Paragraph 2 of this section.

POWER SUPPLY AND DC REGULATION

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
All digital displays are blanked (plus/minus and decimal point indicators are off).	a. 1140 UTMS power switch if OFF.	a. Turns 1140 UTMS power switch to ON.
	b. Line fuse (F5) open.	b. Replace line fuse (F5) on power supply.
	c. Office fuse is open.	c. Replace office fuse.
	d. Defective power supply.	d. With a voltmeter, check both dc regulator outputs. If neither dc regulator is supplying voltages, replace power supply. Ensure that the ground cable is disconnected prior to removal, and reconnected after installation of new power supply.
	e. BCD interconnect cable(s) have been disconnected.	e. Reconnect BCD interconnect cable(s).
All digital displays are blanked (decimal indicators display properly).	−43 Vdc fuse (F1) open.	Replace −43 Vdc fuse (F1) on power supply.
One or more digital displays are blanked (decimal indicators display properly).	−43 Vdc fuse (F1) in display housing(s) is open.	Replace −43 Vdc fuse (F1) in display housing(s).
All digital displays indicate erroneous, blurred or partial readings (plus/minus and decimal indicators may or may not display).	+5 Vdc or +15 Vdc or −15 Vdc fuse is open.	Replace fuse F4 or F3 or F2.
All level and frequency digital displays indicate erroneous readings.	Level/frequency dc regulator output voltages do not meet tolerances given in paragraph 2 Step (c) of this section.	With a voltmeter, check level/frequency dc regulator outputs (see Figure 4-1 and 4-3 for location of test points). If regulator is defective, replace.
All noise digital displays display erroneous readings.	Noise dc regulator output voltages do not meet tolerances given in Paragraph 2 Step (c) of this section.	With a voltmeter, check noise dc regulator outputs (see Figure 4-1 and 4-3 for location of test points). If regulator is defective,replace.

LEVEL MEASURING CIRCUITRY

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
Decimal point on one or more level displays does not illuminate (at least one display indicates properly).	Level display circuit board(s).	Replace defective level display circuit board(s).
One or more level displays are blanked (plus/minus and decimal indicators display properly; at least one level display reads properly).	Level display circuit board(s).	Replace defective level display circuit board(s).
Plus and/or minus indicators on one or more level displays does not indicate (at least one level display reads properly).	Level display circuit board(s).	Replace defective level display circuit board(s).
One or more digits in Nixie display tube does not light (at least one level display reads properly).	Level display circuit board(s).	Replace defective level display circuit board(s).
All level displays indicate a reading other than 0.0 dBm, when the calibration standard is activated.	a. Level measuring circuitry.	a. Inject office milliwatt standard, 0.0 dBm into a level/frequency input channel strapped for 600 ohms. If the problem still exists, refer to step (b). If problem disappears, proceed to step (e).
	b. Level analog circuit board.	b. Replace level analog circuit board.

LEVEL MEASURING CIRCUITRY (Continued)

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
	c. Level digital circuit board.	c. Replace level digital circuit board.
	d. Level/frequency strapping circuit board.	d. Replace level/frequency strapping circuit board.
	e. Calibration standard circuit board.	e. Replace the calibration standard circuit board.
All level displays are blanked (decimal indicator displays properly, plus or minus sign is on).	a. Input signal is out-of-range.	a. Ensure that the input signal is not beyond the TTI 1140 level measurement capability.
	b. Level digital circuit board.	b. Replace level digital circuit board.
	c. Level analog circuit board.	c. Replace level analog circuit board.
	d. Level/frequency strapping circuit board.	d. Replace level/frequency strapping circuit board.
	e. Level/frequency line selector circuit board.	e. Replace level/frequency line selector circuit board.
All level displays are "frozen" (do not change with a changing input). (Frequency displays are good.)	a. External sample inhibit has been activated.	a. Remove external sample inhibit (level).
	b. Level digital circuit board.	b. Replace level digital circuit board.
Plus and/or minus sign on all level displays does not indicate.	a. Level digital circuit board.	a. Replace level digital circuit board.
	b. Level analog circuit board.	b. Replace level analog circuit board.
All level displays indicate a constant error (frequency displays indicate properly).	c. Level/frequency strapping circuit board.	c. Replace level/frequency strapping circuit board.
All level displays indicate a blurred or partial reading (frequency displays indicate properly).	a. Level digital circuit board.	a. Replace level digital circuit board.
	b. Level display circuit board.	b. Isolate and replace bad level display circuit board.
One or more digits in all level displays do not indicate.	Level digital circuit board.	Replace level digital circuit board.
Reading at all level displays will not settle (input is constant).	a. Faulty jack or key.	a. Clean jack or key contacts, repair jack or key wiring.
	b. Level digital circuit board.	b. Replace level digital circuit board.
	c. Level analog circuit board.	c. Replace level digital circuit board.
	d. Level/frequency line selector circuit board.	d. Replace line selector circuit board.
All level displays indicate a constant error of 1.8 dB (termination strapping is good).	a. Level/frequency strapping circuit board.	a. Replace level/frequency strapping circuit board.
	b. Level analog circuit board.	b. Replace level analog circuit board.
All level displays indicate a reading 6 dB high.	a. Open terminating resistor.	a. Replace terminating resistor at appropriate access position.
	b. No termination at jack or key.	b. Check terminating resistor. Clean jack or key contacts.
Busy lamp(s) at one or more level/frequency access points are always illuminated (with plugs removed).	Level/frequency strapping circuit board.	Replace level/frequency strapping circuit board.

LEVEL MEASURING CIRCUITRY (Continued)

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
Busy lamp(s) at one or more level/frequency access points never lights.	a. Defective lamp(s).	a. Reseat or replace lamp(s).
	b. Level/frequency strapping circuit board.	b. Replace level/frequency strapping circuit board.
Level/frequency channel input indicator displays an incorrect number or no number at all.	a. Another position is accessing the 1140 UTMS.	a. NONE
	b. Level/frequency line selector circuit board.	b. Replace level/frequency line selector circuit board.
One or more level/frequency channels are accessed. However, no measurement is made (a number does not appear at the level/frequency input channel indicator).	a. Faulty jack or key.	a. Clean jack or key contacts.
	b. Level/frequency line selector circuit board.	b. Replace level/frequency line selector circuit board.

FREQUENCY MEASURING CIRCUITRY

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
Decimal point on one or more frequency displays does not illuminate (at least one frequency display reads properly).	Frequency display circuit board(s).	Replace defective frequency display circuit board(s).
One or more frequency displays are blanked (decimal indicator displays properly and at least one frequency display reads properly).	Frequency display circuit board(s).	Replace defective frequency display circuit board(s).
One or more digits in a frequency Nixie display tube does not light (at least one frequency display reads properly).	Frequency display circuit board(s).	Replace defective frequency display circuit board(s).
All frequency displays indicate a reading other than 1 kHz, when the calibration standard is activated.	a. Level and frequency measuring circuitry.	a. Inject a test signal of 1.000 kHz (checked with a frequency counter) at a level of 0.0 dBm into a level/frequency input channel strapped for 600 ohms. If the problem still exists, proceed to step (b). If problem disappears, proceed to step (e).
	b. Level analog circuit board.	b. Replace level analog circuit board.
	c. Frequency counter circuit board.	c. Replace frequency counter circuit board.
	d. Level/frequency strapping circuit board.	d. Replace level/frequency strapping circuit board.
	e. Calibration standard circuit board.	e. Replace calibration standard circuit board.
All frequency displays are blanked.	a. Input signal is out-of-range. (−50 dBm to +10 dBm)	a. Ensure that the input signal is not beyond the TTI 1140 frequency measurement capability.
	b. Frequency counter circuit board.	b. Replace frequency counter circuit board.
	c. Level measuring circuitry.	c. Refer to same symptom in level measuring circuitry.
All frequency displays are "frozen" (do not change with a changing input).	a. External sample inhibit has been activated.	a. Remove external sample inhibit (frequency).
	b. Frequency counter circuit board.	b. Replace frequency counter circuit board.

FREQUENCY MEASURING CIRCUITRY (Continued)

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
All frequency displays indicate a blurred or partial reading.	a. Frequency counter circuit board. b. Frequency display circuit board.	a. Replace frequency counter circuit board. b. Isolate and replace bad frequency display circuit board.
One or more digits in all frequency displays does not indicate.	a. Frequency counter circuit board. b. Frequency display circuit board.	a. Replace frequency counter circuit board. b. Isolate the malfunction to one of the frequency display circuit boards.

NOISE MEASURING CIRCUITRY

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
One or more noise displays are blanked (plus/minus indicates properly; at least one noise display reads properly).	Noise display circuit board(s).	Replace defective noise display circuit board(s).
Plus and/or minus indicator on one or more noise displays does not indicate (at least one noise display reads properly).	Noise display circuit board(s).	Replace defective noise display circuit board(s).
One or more digits in Noise Nixie display tube does not light (at least one noise display reads properly).	Noise display circuit board.	Replace defective noise display circuit board.
All noise displays indicate a reading other than +45 dBrn when the calibration standard is activated.	a. Noise measuring circuitry. b. Noise analog circuit board. c. Noise digital circuit board. d. Noise strapping circuit board. e. Calibration standard circuit board.	a. Inject a 1-kHz signal at −45 dBm into a noise input channel strapped for 600 ohms. If the problem still exists, proceed to step (b). If the problem disappears, proceed to step (e). b. Replace noise analog circuit board. c. Replace noise digital circuit board. d. Replace noise strapping circuit board. e. Replace calibration standard circuit board.
All noise displays are blanked (decimal indicator displays properly; plus or minus sign is on).	a. Input signal is out-of-range. (0 dBrn to 60 dBrn) b. Noise digital circuit board. c. Noise analog circuit board. d. Noise strapping circuit board. e. Noise line selector circuit board. f. Noise filter circuit board.	a. Ensure that the input signal is not beyond the TTI 1140 noise measuring capability. b. Replace noise digital circuit board. c. Replace noise analog circuit board. d. Replace noise strapping circuit board. e. Replace noise strapping circuit board. f. Replace noise filter circuit board.
All noise displays are "frozen" (do not change with a changing input).	a. External sample inhibit has been activated. b. Noise digital circuit board.	a. Remove external sample inhibit (noise). b. Replace noise digital circuit board.
Plus and/or minus signs in all noise displays do not indicate.	Noise digital circuit board.	Replace noise digital circuit board.

NOISE MEASURING CIRCUITRY (Continued)

SYMPTOM	PROBABLE CAUSE	CHECK AND REMEDY
All noise displays indicate a constant error.	a. Noise digital circuit board. b. Noise analog circuit board. c. Noise strapping circuit board.	a. Replace noise digital circuit board. b. Replace noise analog circuit board. c. Replace noise strapping circuit board.
All noise displays indicate a blurred or partial reading.	a. Noise digital circuit board. b. Noise display circuit board.	a. Replace noise digital circuit board. b. Isolate and replace bad noise display circuit board.
One or more digits in all noise displays do not indicate.	Noise digital circuit board.	Replace noise digital circuit board.
Reading at all noise displays will not settle (input is constant).	a. Faulty jack or key. b. Noise digital circuit board. c. Noise analog circuit board. d. Noise line selector circuit board.	a. Clean jack or key contacts. b. Replace noise digital circuit board. c. Replace noise analog circuit board. d. Replace noise line selector circuit board.
All noise displays indicate a constant 1.8 dB error (termination strapping is good).	a. Noise strapping circuit board. b. Noise analog circuit board.	a. Replace noise strapping circuit board. b. Replace noise analog circuit board.
All noise displays indicate a reading 6 dB high.	a. Open terminating resistor. b. No termination at jack or key.	a. Replace terminating resistor at appropriate access position. b. Check terminating resistor. Clean jack or key contacts.
Busy lamp(s) at one or more noise access points are always illuminated (with all plug(s) removed).	Noise strapping circuit board.	Replace noise strapping circuit board.
Busy lamp(s) at one or more noise access points never lights.	a. Defective lamp(s). b. Noise strapping circuit board.	a. Reseat or replace lamp(s). b. Replace noise strapping circuit board.
Noise channel input indicator displays an incorrect number or no number at all.	a. Another position is accessing the 1140 UTMS. b. Noise line selector circuit board.	a. NONE b. Replace noise line selector circuit board.
One or more noise channels are accessed. However, no measurement has been made (a number does not appear at the noise input channel indicator).	a. Faulty jack or key. b. Noise line selector circuit board.	a. Clean jack or key contacts. b. Line selector circuit board.

SECTION 4

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM* (UTMS)

INSTALLATION INSTRUCTIONS

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1. GENERAL

1.01 This section contains unpacking, installation, and checkout instructions for the TTI 1140 Universal Transmission Measuring System (UTMS*). It is intended for use with the following 1140 drawings located at the back of this section.

J1140-001 thru J1140-004, J1140-007 and J1140-008 } Eqpt Assy Dwgs

S1140-A01 and S1140-B01, S1140-G01 thru S1140-G03 } Schem Intercon Dwgs

T1140-A01 and T1140-B01, T1140-B03 thru T1140-B05 } Pt-to-Pt Wrg Dwgs

1.02 The Installation Instructions are arranged in chronological order that permits partial checkout of the equipment at various stages of installation. Thus, any problems that arise during installation can be quickly isolated and solved by reference to the installation trouble-locating procedures in Section 3 of this manual.

1.03 The UTMS is extensively tested and calibrated at the factory. Therefore, minimum test equipment is required to verify correct installation. Table 4-1 lists the test equipment and tools required to install the 1140 UTMS:

Table 4-1. Required Installation Equipment

EQUIPMENT TYPE	CHARACTERISTICS
1-kHz Oscillator	Balanced 600-ohm input, capable of producing signals at 0 dBm and −45 dBm
Multimeter	20,000 ohms per volt
Soldering Iron	35-watt (No greater)
Solder	Resin core (DO NOT use acid core)
Wire Wrap Tool	For 24-gauge wire Gardner-Denver 14H-1C or Bell KS-16363 or equivalent
Hand Tools	Normal installation hand tools

If it is desired to check the accuracy of the UTMS, or if extensive trouble shooting is required, more precise instruments are necessary. Such tests require a frequency counter accurate to 0.5 Hz at 1 kHz, an oscillator similar to that listed in Table 4-1, with an output impedance accurate to ±0.1%,

*TM

and to set up the oscillator a 600-ohm bridging and terminating level meter accurate to 0.03 dB.

2. UNPACKING AND INSPECTION

2.01 The equipment shelf of the UTMS is shipped fully equipped in a single packing container. All plug-in circuit boards for the measuring units and accessories ordered are shipped in place in the equipment shelf. The only detached items are the two rack mounting ears, and their associated screws, which are taped to the top of the inner shipping carton. Care should be exercised to avoid discarding these rack mounting ears with the shipping materials. Display housings are packed in separate shipping containers, and the display circuit boards ordered are installed in the proper display housing.

2.02 Unpack the equipment and make a visual inspection for signs of obvious damage. In the event of such damage, retain all packing materials and contact freight carrier.

3. CABLING

3.01 All cabling for signal inputs, BCD outputs to the displays, dc control functions, and power inputs should be pulled through before the UTMS is mounted and wired.

4. INITIAL INSTALLATION

4.01 These instructions must be followed without deviation. Otherwise severe damage to the equipment may result. Damage caused by wiring errors or by failure to follow these instructions is not covered by the equipment warranty. Do not apply power to the UTMS until steps (a) through (q) have been completed. If improper operation is observed at any point in the installation procedure, refer to the installation trouble-locating procedures in Section 3 of this manual.

a. Attach the rack-mounting ears to the equipment shelf. For mounting in a 19-inch rack, the long side of these L-shaped ears should be screwed to the equipment shelf. For mounting in a 23-inch rack, the short side should be screwed to the equipment shelf. The ears may be attached flush with the front of the equipment shelf, or five inches back from the front, depending on the desired mounting configuration (See Drawing J1140-002, Sheet 1, Zone D-2).

b. Make sure the grounding strap from pin P3A on the mother board is firmly attached to the top of the power supply (See Drawing T1140-B01, Sheet 1, Zone C-3, 4 for terminal P3A location). Also ensure the three ribbon connectors between the two printed circuit boards on the rear of the equipment shelf are firmly seated (See Drawing J1140-002, Sheet 2, Table B).

c. Mount equipment shelf to the equipment rack (See Drawing J1140-002, Sheet 1). Remove the front cover from the equipment shelf, and remove the packing material from behind the cover.

d. Remove the fuse from the central office power cable (See Drawing T1140-B05, Figure 1, Zone B-3), and make certain the UTMS power switch is turned OFF.

CAUTION

Since the UTMS may be equipped with either a −48 Vdc or a 115 Vac power supply, it is imperative that the power connection have the correct voltage and polarity for the power supply provided, otherwise severe damage to the equipment shelf may result.

e. Remove all equipment shelf (plug-in) circuit boards, including the two dc regulator circuit boards bolted to the dividers near the center of the shelf (See Drawing J1140-002, Sheet 2, Zone E-2).

f. Mount displays in accordance with the following drawings:

1. J1140-003 (TTI 1140A-2 List 9, aisle mount display).
2. J1140-004 (TTI 1140A-2 List 8, rack mount display).
3. J1140-007 (TTI 1140A-2 List 10, horizontal panel mount display).
4. J1140-008 (TTI 1140A-2 List 12, vertical panel mount display).

Remove all display circuit boards from all display housings. Take care to store the circuit boards in a safe place until reinserted into the proper display housings. Be especially careful with the display tubes.

g. Solder power connections to the power input terminals at the rear of the equipment shelf in accordance with Table 4-2 (See Drawing T1140-B01 Sheet 1 for the location of the power terminals).

Table 4-2. Power Connections

POWER SUPPLY	CONDUCTOR	PIN
115 Vac	115 Vac-Hot (Black) Return (White) Ground (Green)	P2 P1 P3
−48 Vdc*	−48 Vdc Frame Ground Braid To P/S	P2 P1 P3A

*P1 (Frame GRD) is Shorted to P3 (System GRD).

h. Connect all input channel cabling to the input channel terminals at the lower rear section of the equipment shelf in accordance with drawings:

1. J1140-002 Sheet 2, Table D.
2. S1140-B01 Sheet 1, Table 1 and S1140-B01 Sheets 2 and 3.
3. S1140-G01, G02, and G03.
4. T1140-B01 Sheets 1 and 2.
5. T1140-B03 Sheet 1, Table 1.
6. T1140-B05 Sheet 1.

Also ensure all jack, lamp, relay and key connections are properly made at the corresponding test board positions. Ensure that proper terminating resistors are installed at the jacks in accordance with the requirements for switched access or multipled access (reference Note 58 on Drawing T1140-B05 Sheet 1).

NOTE 1

The UTMS will not operate unless each signal access jack provides for contact closure from pin 3 to pin 5 of terminals TS11, TS12, etc. This is automatically taken care of when the system installation includes the jack configuration specified on the drawings mentioned above. All access arrangements must provide means for making a contact closure from pin 3 to pin 5, either by extra jack contacts, as detailed in the drawings, or by auxiliary relay contacts.

NOTE 2

Access and display positions are as assigned by engineer/customer. These assignments refer to position numbers 1 through 10 on the BCD−output circuit board and the channel input terminals at the rear of the equipment shelf. They also refer to positions 1 through 10 on the strapping board (P1140-009) for systems equipped with scanning lockout switches (TTI 1140A-2 List 3).

i. Connect all display wiring to the equipment shelf BCD-output positions in accordance with drawings:

1. J1140-002 Sheet 2, Table C.
2. S1140-G01 Sheet 1, CAD 1, 2 and 3.
3. S1140-G02 Sheet 1, CAD 1.
4. S1140-G03 Sheet 1, CAD 2 and 3.
5. T1140-B01 Sheets 1 and 2.
6. T1140-B03 Sheet 1, Table 2.
7. T1140-B04 Sheets 1 and 2.

Pin numbers on the drawings correspond to silk-screened numbers on the rear of the equipment shelf and on the display housing connectors. The pin numbers are for orientation only. Count from the end of the terminal to ensure that you are wiring the correct pin. Figure 4-1 shows the functions of all 24 leads connected between the equipment shelf BCD-output terminals and the display housing connector pins for frequency, noise, and level. If for example you wish to know the function of pin 8 between the equipment shelf and a level display, first find terminal/pin 8 in Figure 4-1. Then go across to the (dBm) column and find the function (L1). Lead 8 is then the 1 bit of the units digits (dBm).

CAUTION

Pins 22, 23 and 24 on each terminal block on the rear of the equipment shelf and on each display housing carry power to the displays. Use special care in wire-wrapping these pins—particularly pins 23 and 24. Make sure no lead touches another lead. A misconnection, a short to an adjacent pin, or a short to ground may cause severe damage to the UTMS. Such wiring errors are not covered by the equipment warranty.

TERMINAL/PIN NUMBER	FREQUENCY kHz	NOISE dBrn	LEVEL dBm
1	D8	Not Used	Not Used
2	D4 Thousands	M4 Tens	M4
3	D2 Hz	M2 dBrn	M2 Tens
4	D1	M1	M1 dBm
5	C8	L8	L8
6	C4 Hundreds	L4 Units	L4 Units
7	C2 Hz	L2 dBrn	L2 dBm
8	C1	L1	L1
9	B8	Not Used	K8
10	B4 Tens	Not Used	K4 Tenths
11	B2 Hz	Not Used	K2 dBm
12	B1	Not Used	K1
13	A8	Not Used	Not Used
14	A4 Units	Not Used	Not Used
15	A2 Hz	Not Used	Not Used
16	A1	Not Used	Not Used
17	*OOR Blanking	*OOR Blanking	*OOR Blanking
18	10-Hz Decimal	Minus (—)	Minus (—)
19	1-Hz Decimal	Plus (+)	Plus (+)
20	Sel. Blanking	Sel. Blanking	Sel. Blanking
21	GRD	GRD	GRD
22	+5 Vdc	+5 Vdc	+5 Vdc
23	+15 Vdc	+15 Vdc	+15 Vdc
24	—43 Vdc (Fused)	—43 Vdc (Fused)	—43 Vdc (Fused)

* OOR = Out Of Range.

Figure 4-1. BCD-Output/Display Terminals.

j. Make pin-to-pin continuity checks on all connections between the equipment shelf and the displays. Since the circuit boards have been removed, this may be done with an ohmmeter or a bell and battery. If continuity checks are made with the circuit boards plugged in, DO NOT USE A BELL AND BATTERY, as the battery voltage may damage the circuit boards.

k. Check all displays to make sure there is continuity from pin 21 to office frame ground. A lack of continuity indicates a wiring error or a lack of equipment shelf grounding.

l. Make ohm checks from ground terminal P3 on the mother circuit board (See Drawing T1140-B01, Sheet 1, Zone C-3 for location) to the following terminals on the upper left and upper right portions of the BCD-output circuit board on the rear of the equipment shelf (See Drawing J1140-002 Sheet 1 for exact location).

Left Side	Right Side
+5 VRN	—43 Vdc
+15 VN	+15 VL
+5 VRL	+5 VL

As shown on Drawing J1140-002 Sheet 2, the BCD-output circuit board is the farthest to the rear. The other circuit board toward the rear of the equipment shelf is the primary interconnect or mother circuit board. With the exception of the —43 Vdc terminal, all terminals should indicate an infinite resistance to ground. The —43 Vdc terminal should indicate 3-4K ohms or 11K ohms, depending on the polarity of the ohmmeter leads. If a reading less than 3K ohms is detected, there is a defect in external wiring. Clear the fault and start again with step (j).

m. Visually inspect the wire wrap connections at pins 23 and 24 on each terminal block on the rear of the equipment shelf and on each display (See Figures 4-2 and 4-3). Make sure

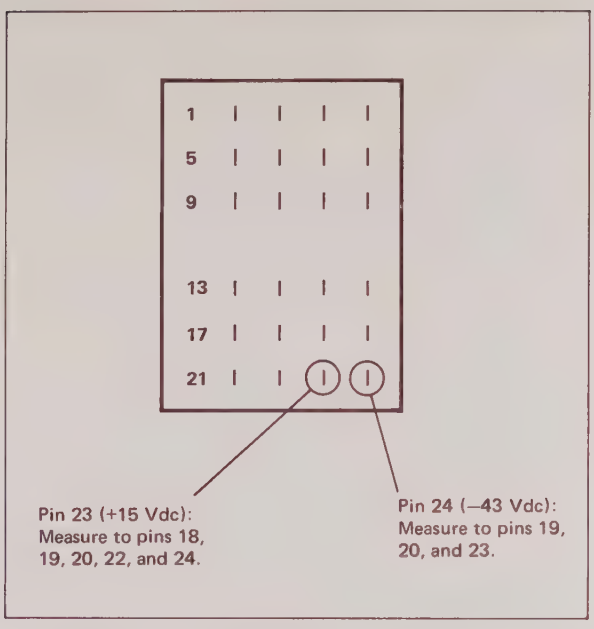


Figure 4-2. BCD-Output Terminal Block (Typical 30 Places).

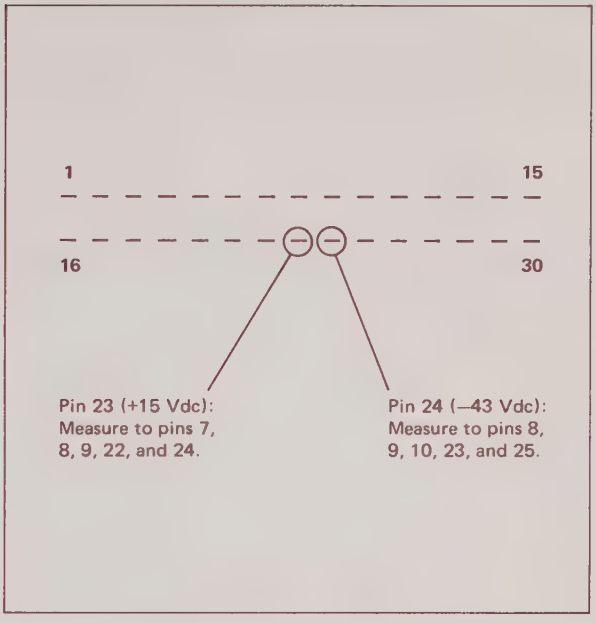


Figure 4-3. Display Connector (Typical 3 Places Each Display Housing).

there is adequate clearance between the wire-wrap connections and adjacent pins and other wires. Then use an ohmmeter to make continuity checks from all pins 23 and 24 to adjacent pins, as shown in Figures 4-2 and 4-3. Any Reading Less Than Infinity Indicates A Wiring Error That May Severely Damage The UTMS If Not Cleared. If a fault is detected clear the fault and start again with step (j).

n. Check for shorts between any of the six power terminals called out in step (l). If a short exists, clear the fault and start again at step (m).

o. During the following measurements, ensure that all plugs are removed from the access jacks that interface with the UTMS being installed. With an ohmmeter, check continuity from pin 4 of level/frequency input channel 1, TS11, to pin 5 of TS11 through TS20. Check all ten level/frequency input channels even though they may not all be used. All ten measurements must indicate open circuits. Make identical measurements from pin 4 of noise input channel 1, TS21, to pin 5 of TS21 through TS30. Check all ten noise input channels even though they may not all be used. All ten measurements must indicate an open circuit. Any reading other than an open circuit must be cleared before proceeding. Figure 4-4 shows the function of the input channel terminals, and can be used for all ten level/frequency and noise input channels, simply by inserting the proper channel number between "TS" and the pin number.

p. With an ohmmeter, check continuity from pin 1 of level/frequency input channel 1, TS11, to pin 5 of TS11 through TS20. Check all ten level/frequency input channels even though they may not all be used. All ten measurements must indicate open circuits. Make identical measurements from pin 1 of noise input channel 1, TS21, to pin 5 of TS21 through TS30. Check all ten noise input channels even though they may not all be used. All ten measurements must indicate an open circuit. Any reading other than an open circuit must be cleared before proceeding (See Figure 4-4 for input terminal functions).

q. Insert the two dc regulator boards (P1140-004) in the equipment shelf per Drawing J1140-002, Sheet 2, Zone E-2. (One regulator circuit board is for the level/frequency circuitry, and one is for the noise circuitry). Ensure that the circuit boards are bolted securely to their respective shelf dividers with the hardware removed in step (e) as these dividers serve as heat sinks. The dc regulator circuit

*TERMINAL NO.	FUNCTION	INPUT/OUTPUT	ACCESS JACK PIN NO.
T1	Tip	Input	7
R1	Ring	Input	4
S1	Sleeve**	Input	Shield
TS11-1	—48 Vdc Common Bus	Output	6
TS11-2	Not Used	Not Used	No Conn.
TS11-3	Ground Common Bus	Output	2
TS11-4	Lamp/Relay Battery Common Bus	Input	5
TS11-5	Line Selector Control	Input	3
TS11-6	Lamp/Relay Return	Return	Busy Circuit
A	Line Selector Position, BCD 1	Output	No. Conn.
B	Line Selector Position, BCD 2	Output	No. Conn.
C	Line Selector Position, BCD 4	Output	No. Conn.
D	Line Selector Position, BCD 8	Output	No. Conn.

* Level/Frequency Channel 1 Shown.

** Do not connect to Pin 1 on Jack (Jack Terminal Sleeve).

Figure 4-4. Equipment Shelf Input Channel Terminals.

boards are identical. Thus, either circuit board may be inserted into either dc regulator slot.

r. Reinstall central office fuse, removed in step (d), and turn the UTMS power switch to ON. With a dc voltmeter, check test points on the dc regulator circuit boards for the voltages shown in Table 4-3. (These measurements must be made with respect to the ground (GRD) test point on the dc regulator circuit boards.

Table 4-3. DC Regulator Test Points

TP	VOLTAGE	TOLERANCE
TP4	+5 Vdc	±0.5 Vdc
TP3	+5 Vdc	±0.5 Vdc
TP2	—15 Vdc	±0.5 Vdc
TP1	+15 Vdc	±0.5 Vdc

NOTE

Do not make any measurements, connections or adjustments to either the rear of the equipment shelf or pins on the displays while the UTMS power switch is on.

s. Turn the UTMS power switch to OFF.

NOTE

Steps (t) thru (x) apply only to systems equipped with scanning lockout switches, TTI 1140A-2 List 3. Do not perform steps (y) and (z). If your system is NOT equipped with scanning lockout switches, skip steps (t) thru (x) and continue at step (y).

LEVEL/FREQUENCY STRAPPING

t. Obtain strapping circuit board (P1140-009), removed in step (e). The strapping circuit boards are identical prior to adding the straps. Therefore either circuit board may be installed in either strapping circuit board slot (See Drawing J1140-002, Sheet 2, Zone E-1 and 2 for locations).

u. Select one strapping circuit board for level/frequency strapping and mark it as such to prevent future confusion. The level/frequency strapping circuit board only requires strapping of the functions shown in Table 4-4. Filter strapping is not required at the level/frequency strapping circuit board "FILTER" positions.

v. Wire wrap between the COMM terminal and the function terminal only for those strap-

Table 4-4. Level/Frequency Strapping Options

Blanking (Blnking)	Blank or Unblank
Frequency Resolution (FREQ)	1-Hz or 10-Hz
Termination Impedance (IMP)	*135-ohm or 600-ohm or 900-ohm

*135-ohm capability is not standard.

ping positions having the corresponding input channels wired. For example, suppose channel 1, TS11, and channel 2, TS12, were the only level/frequency input channels wired. This means that ONLY positions 1 and 2 on the strapping circuit board require strapping. Figure 4-5 shows examples of strapping configurations at position 1 and position 2. Position 1 is strapped as follows:

1. BLNKING — (COMM to UNBLANK)
2. FREQ — (COMM to 1.0 Hz)
3. IMP — (COMM to 600 ohm)

Position 2 is strapped as follows:

1. BLNKING — (COMM to BLANK)
2. FREQ — (COMM to 10 Hz)
3. IMP — (COMM to 900 ohm)

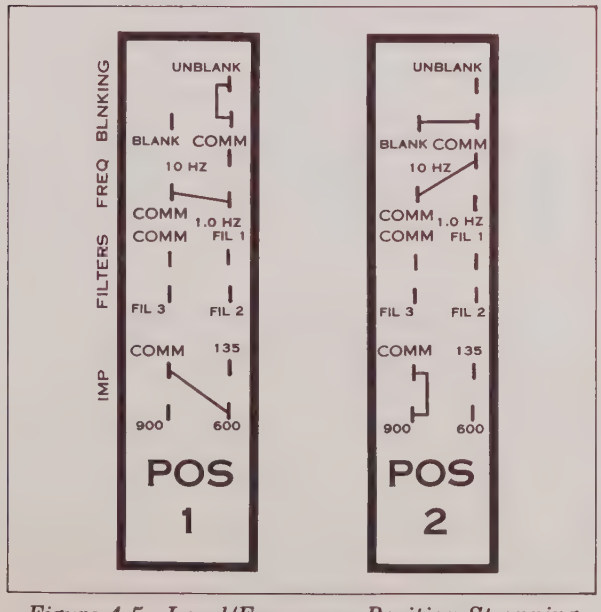


Figure 4-5. Level/Frequency Position Strapping.

NOTE 1

Blanking (BLNKING). Strapping a position for BLANKED operation causes the display connected to the corresponding BCD-output position to be OFF until the corresponding input channel is accessing the measuring unit. When a position is strapped for UN-BLANKED operation, the corresponding display provides a readout when any of the ten input channels are accessed. See paragraph 6 (page 4-13) and Figure 4-8, in this section, for selective blanking variations.

NOTE 2

Frequency (FREQ). Strapping a position for 10-Hz resolution causes the display connected to the corresponding BCD-output position to indicate a frequency measurement to the nearest 10 Hz, over a frequency range of 60 Hz to 60 kHz when the corresponding input channel is accessing the measuring unit. When the position is strapped for 1.0-Hz resolution, the display provides a frequency read-out to the nearest 1 Hz over a frequency range of 100 Hz to 9.999 kHz.

NOTE 3

Impedance (IMP). Impedance strapping at each position must correspond with the value of the terminating resistor installed at the jack access for that particular position.

NOISE STRAPPING

w. Select one strapping circuit board for noise strapping and mark it as such to prevent future confusion. The noise strapping circuit board only requires the strapping of functions shown in Table 4-5. Frequency resolution strapping is not required at the noise strapping circuit board "FREQ" positions.

Table 4-5. Noise Strapping Options

Blanking (Blnking)	Blank or Unblank
Filter	Filter 1 or 2 or 3
Termination Impedance (IMP)	*135-ohm or 600-ohm or 900-ohm

*135-ohm capability is not standard.

x. Wire wrap between the "COMM" terminal and the function terminal only for those strapping positions having the corresponding input channels wired. For example, suppose channel 1, TS21, and channel 2, TS22, were the only noise input channels wired. This means that ONLY positions 1 and 2 on the strapping circuit board require strapping. Figure 4-6 shows examples of strapping configurations at position 1 and 2. Position 1 is strapped as follows:

1. BLNKING — (COMM to UNBLANK)
2. FILTERS — (COMM to FIL 1)
3. IMP — (COMM to 600 ohm)

Position 2 is strapped as follows:

1. BLNKING — (COMM to BLANK)
2. FILTERS — (COMM to FIL 2)
3. IMP — (COMM to 900 ohm)

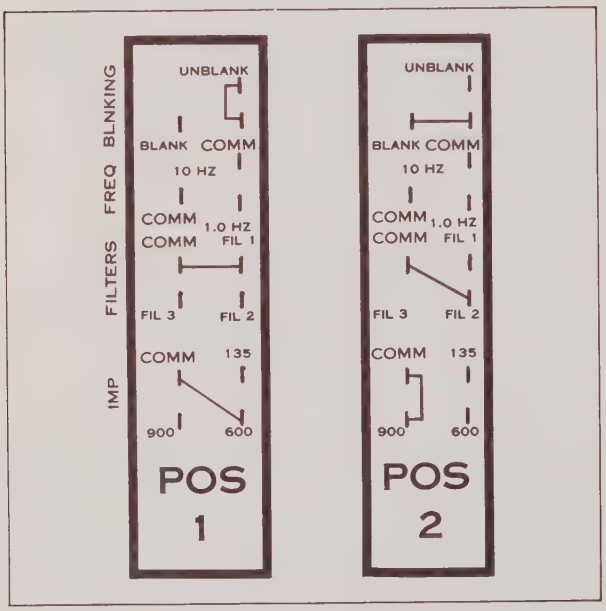


Figure 4-6. Noise Position Strapping.

NOTE 1

Blanking (BLNKING). Strapping a position for BLANKED operation causes the display connected to the corresponding BCD-output position to be OFF until the corresponding input channel is accessing the measuring unit. When a position is strapped for UNBLANKED operation, the corresponding display provides a readout when any of the ten input channels are accessed. See paragraph 6 (page 4-13) and Figure 4-8, in this section, for selective blanking variations.

NOTE 2

Filters. Two noise weighting networks are standard equipment in the UTMS noise measuring unit. One of three optional weighting networks may be added as filter #3 to the UTMS noise measuring unit. Table 4-6 shows the weighting networks and strapping necessary to select the desired weighting network.

Table 4-6. Noise Filter Strapping

FILTER STRAPPING	WEIGHTING NETWORK TYPE
Fil 1 to Comm Fil 2 to Comm Fil 3 to Comm	C-Message (Standard) 3-kHz Flat (Standard) Program (Optional) 15-kHz Flat (Optional) 50-kb/s Data (Optional)

NOTE 3

Impedance (IMP). Impedance strapping at each position must correspond with the value of the terminating resistor installed at the jack access for that particular position.

SUBSTITUTE STRAPPING

y. If the system is not equipped with scanning lockout switches TTI 1140A-2 List 3, strap and solder the level/frequency multiple strapping circuit board (P1140-014) from the common terminal to the function terminal shown in Table 4-7. BLANKING and FILTER strapping are not available on the multiple strapping circuit board. Once this board is strapped, all ten level/frequency input channels are multipled with the options strapped. For an explanation of the strapping, see Notes 2 and 3 in step (v).

Table 4-7. Level/Frequency Strapping Options

Frequency Resolution (FREQ)	1 Hz or 10 Hz
Termination Impedance (IMP)	*135 ohm or 600 ohm or 900 ohm

*135-ohm capability is not standard.

z. If the system is not equipped with scanning lockout switches, TTI 1140A-2 List 3, strap

and solder the noise multiple strapping circuit board (P1140-014) from the common terminal to the function terminal shown in Table 4-8. BLANKING strapping is not available on the multiple strapping circuit board. Once this board is strapped, all ten noise input channels are multipled with the options strapped. For an explanation of the strapping, see Notes 2 and 3 of step (x).

Table 4-8. Noise Strapping Options.

Filters	Fil 1 or 2 or 3
Termination Impedance	*135 ohm or 600 ohm or 900 ohm

*135-ohm capability is not standard.

CIRCUIT BOARD INSTALLATION

Level/Frequency Scanning Lockout Switch.

aa. If the system is equipped with scanning lockout switches, TTI 1140A-2 List 3, insert the circuit boards that comprise the scanning lockout switch for the level/frequency access channels as shown on Drawing J1140-002, Sheet 2, Zone E-1. If the multiple circuit boards discussed in step (y) are used, insert the multiple strapping circuit board (P1140-014) in place of the strapping circuit board (P1140-009) and the multiple line selector circuit board (P1140-013) in place of the line selector circuit board (P1140-010).

bb. Turn the UTMS power switch to ON. Ensure that no busy lamps are lighted at the test board positions with all plugs removed.

cc. Insert a plug into the level/frequency access jack at each test board position and, if the system is equipped with scanning lockout switches, ensure that the appropriate access position number is displayed by the level/frequency channel indicator tube at the equipment shelf.

dd. Check for proper busy lamp operation. For systems equipped with scanning lockout switches, proper busy lamp operation can be verified as follows: Plug into the level/frequency jack for position 1. Level/frequency busy lamps at all positions, except position 1, should light. Then withdraw the plug from position 1 and plug into the level/frequency access jack for position 2. All level/frequency busy lamps, except the one at position 2, should light. Continue this procedure until all positions have been checked.

No Scanning Lockout Switch.

ee. For systems not equipped with scanning lockout switches, all level/frequency busy lamps should light whenever a plug is inserted in any level/frequency access jack.

ff. Turn the UTMS power switch to OFF.

Level Measuring Unit.

gg. If the system is equipped with the level measuring unit, TTI 1140B-2 List 1, insert the level measuring unit circuit boards into the equipment shelf as shown on Drawing J1140-002, Sheet 2, Zone A-3. Insert a level display circuit board into ONE display housing ONLY, for testing of the level measuring unit. (See Drawings J1140-003, 004, 007, 008).

hh. Turn the UTMS power switch to ON and check to see that the level display is blanked, except for a "—" sign and a decimal point indicator.

ii. Apply a 1-kHz signal at a level of 0.00 dBm to the level/frequency input jack associated with the test display and check the display for a reading of 0.0 dBm ±0.1 dB.

Frequency Measuring Unit.

jj. If the system is equipped with the frequency measuring unit, TTI 1140C-2 List 1, turn the UTMS power switch to OFF and insert the frequency counter circuit board (P1140-057) into the frequency counter slot as shown on Drawing J1140-002, Sheet 2, Zone A-3. Insert a frequency display circuit board into the test display discussed in step (gg) (See Drawings J1140-003, 004, 007, and 008).

kk. Turn the UTMS power switch to ON and apply a 1.000 kHz test signal at the

access position associated with the test display discussed in step (gg). If the particular test position is strapped for a frequency resolution of 1 Hz, check the display for a reading of 1.000 kHz ±0.001 kHz. If the position is strapped for a frequency resolution of 10 Hz, check the display for a reading of 1.00 kHz ±0.01 kHz.

ll. Turn the UTMS power switch to OFF.

Noise Scanning Lockout Switch.

mm. If the system is equipped with scanning lockout switches, TTI 1140A-2 List 3, insert the circuit boards that comprise the scanning lockout switch for the noise access channels as shown on Drawing J1140-002, Sheet 2, Zone E-1. If the multiple circuit boards discussed in step (z) are used, insert the multiple strapping circuit board (P1140-014) in place of the strapping circuit board (P1140-009) and the multiple line selector circuit board (P1140-013) in place of the line selector circuit board (P1140-010).

nn. Turn the UTMS power switch to ON. Ensure that no busy lamps are lighted at the test board positions with all plugs removed.

oo. Insert a plug into the noise access jack at each test position. Ensure that the appropriate access position number is displayed by the noise channel indicator tube at the equipment shelf. Also check for proper busy lamp operation. Busy lamp operation is the same as that for the level/frequency access channel, described in steps (dd) and (ee).

pp. Turn the UTMS power switch to OFF.

Noise Measuring Unit.

qq. If the system is equipped with the noise measuring unit, TTI 1140D-2 List 1, insert the noise measuring unit circuit boards into the equipment shelf as shown on Drawing J1140-002, Sheet 2, Zone A-2. Insert a noise display circuit board into the display housing discussed in step (gg), for testing of the noise measuring unit (See drawings J1140-003, 004, 007, and 008).

rr. Turn the power switch to ON.

ss. Apply a 1-kHz signal at a level of —45.0 dBm to the noise input jack associated with the test display. Then check the display for a reading of 45 ±1 dBrn.

tt. Turn the UTMS power switch to OFF and plug the remaining display circuit boards (level, noise, and frequency) into the display housings that have been connected to the equipment shelf BCD-output positions (See Drawings J1140-003, 004, 007, and 008).

uu. Turn the UTMS power switch to ON and check each display for the proper readings by applying the signals called out in steps (ii), (kk), and (ss), at the appropriate access positions.

vv. Turn the UTMS power switch to OFF.

Calibration Standard

ww. If the system is equipped with the calibration standard, TTI 1140A-2 List 4, strap the level/frequency strapping circuit board, position 10, as shown in Figure 4-7a. Strap the noise strapping circuit board, position 10, as shown in Figure 4-7b (See Note 61 on drawing T1140-B01 Sheet 1).

NOTE

The calibration standard option TTI 1140A-2 List 4 requires scanning lockout switches, TTI 1140A-2 List 3.

xx. Insert the calibration standard circuit board into the equipment shelf as shown on Drawing J1140-002, Sheet 2, Zone E-1.

yy. Turn UTMS power switch to ON and activate the calibration standard with the calibrate key (switch). Both input channel indicators at the equipment shelf must display "0", indicating level/frequency channel 10 and noise channel 10 are being accessed. Check an unblanked display or the display associated with position 10 on the strapping circuit boards for the readings shown in Table 4-9.

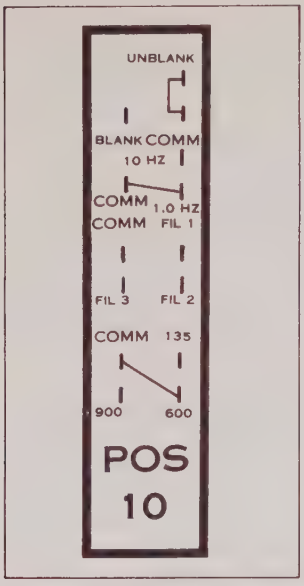


Figure 4-7a. Level/Frequency Calibrate Strapping

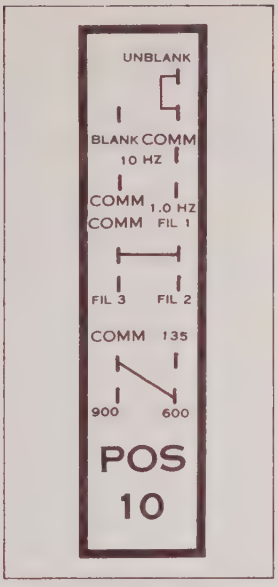


Figure 4-7b. Noise Calibrate Strapping

Table 4-9. Calibrate Reading

Level dBm	0.0 dBm ±0.0 dB
Frequency kHz	1.000 kHz ±0.000 kHz
Noise dBrn	45 dBrn ±0 dB

NOTE

In order for the calibration standard to function, at least one level/frequency and noise display position must be operating unblanked, or one display must be connected to BCD-output position 10.

zz. Turn the UTMS power switch to OFF and place covers on the equipment shelf and displays as shown on Drawings J1140-002 Sheet 1, J1140-003, 004, 007, and 008.

aaa. Turn the UTMS power switch to ON and exercise the system by applying the test signals described in steps (ii), (kk), and (ss), at each access position. Check all displays for proper operation from each access position. If the system is equipped with scanning lockout switches, TTI 1140A-2 List 3, ensure that the proper displays are blanked when the signal is applied at each access position. If the system is NOT equipped with scanning lockout switches, all displays must indicate the same reading from any access position.

bbb. The UTMS is NOW READY FOR USE.

5. SYSTEM EXPANSION

5.01 Since the UTMS is a modular system, it may be expanded after initial installation and checkout. If all wiring has been done in accordance with the "S" and "T" drawings at the time of initial installation, no new wiring is necessary for certain types of expansion. **Perform steps 4.01(e) and 4.01(f) before proceeding.**

FREQUENCY MEASURING UNIT

5.02 If system expansion involves the addition of the frequency measuring unit TTI 1140C-2 List 1, into a system already equipped with the level measuring unit TTI 1140B-2 List 1, it is only necessary to turn the UTMS power switch to OFF, remove the covers from the equipment shelf and displays (See "J" drawings), insert the frequency counter circuit board (P1140-057) into the frequency measuring unit slot (See J1140-002 Sheet 2, Zone A-3 for location), and install the frequency display circuit boards in the display housings as shown on Drawings J1140-003, 004, 007, and 008. Then replace the equipment covers, turn the UTMS power switch to ON, and check the system out in accordance with Paragraph 4.01, steps (jj) and (kk) on pages 4-9 and 4-10.

NOTE

The level measuring unit, TTI 1140B-2 List 1 is required for the frequency measuring unit TTI 1140C-2 List 1.

LEVEL MEASURING UNIT

5.03 If system expansion involves the addition of a level measuring unit, TTI 1140B-2 List 1, to a system not equipped with one, perform the procedures in steps (gg) thru (ii) and (tt) and (uu).

NOISE MEASURING UNIT

5.04 If system expansion involves the addition of a noise measuring unit, TTI 1140D-2 List 1, to a system not equipped with one, perform the procedures in steps (qq) thru (uu).

SCANNING LOCKOUT SWITCH

5.05 Another example of system expansion which requires no new wiring is the addition of scanning lockout switches. If the initial wiring has been done in accordance with drawings

T1140-B01 through T1140-B05, only a circuit board change is necessary.

Proceed as follows:

a. Turn the UTMS power switch to OFF, and remove the cover from the equipment shelf (See Drawing J1140-002, Sheet 1, Zone G-0).

b. Remove the multiple boards (P1140-013) and the multiple strapping boards (P1140-014). (There is one multiple board and one multiple strapping board for the level/frequency access channel and an identical set of boards for the noise access channel.)

c. Strap the new strapping boards (P1140-009) in accordance with steps (t) thru (x).*

d. Then replace each set of the multiple boards with the two circuit boards that make up the scanning lockout switch as shown on Drawing J1140-002, Sheet 2, Zone E-1, 2. These are the strapping board (P1140-009) and the line selector board (P1140-010).

e. Turn the UTMS power switch to ON and check system operation in accordance with Paragraph 4.01, steps (bb) thru (dd).*

f. Turn the UTMS power switch to OFF and replace the equipment shelf cover.

NOTE

For terminated measurements, terminating resistors must be installed at each access jack when scanning lockout switches are used.

INPUT POSITIONS

5.06 If the system expansion involves the connection of new access (input) positions or changes to existing access positions, but does not include any changes in display connections, proceed as follows:

a. Turn the UTMS power switch to OFF. Then remove the front cover from the equipment shelf (See Drawing J1140-002, Sheet 1, Zone G-0).

b. If the system is equipped with scanning lockout switches, remove the circuit boards comprising the scanning lockout switches (See Drawing J1140-002, Sheet 2, Zone E-1). Be careful not to interchange the level/frequency and noise strapping circuit boards.

c. Connect the new access position wiring in accordance with Drawings T1140-B01, T1140-B03, and T1140-B05.

d. Use an ohmmeter to make the checks in steps (o) and (p).*

e. If the system is equipped with scanning lockout switches, TTI 1140A-2 List 3, strap the level/frequency strapping board position(s) for the new input position(s) by performing steps (t) through (v).* Strap the noise strapping board position(s) for the new input position(s) by performing steps (w) and (x).*

f. Replace the level/frequency and noise scanning lockout switch circuit boards into the equipment shelf as shown on Drawing J1140-002, Sheet 2, Zone E-1, 2.

g. Turn the UTMS power switch to ON and make the checks in steps (bb) through (ee).*

h. Turn the UTMS power switch to OFF and replace the equipment shelf front cover.

i. Turn the UTMS power switch to ON.

DISPLAYS

5.07 If the system expansion involves any changes to existing display connections or additions of new displays, the following procedure must be followed to avoid the possibility of damage to the UTMS and to ensure that the displays function properly.

a. Turn the UTMS power switch to OFF, and remove the fuse from the main power connection (See Drawing T1140-B05 Sheet 1, Figure 1).

b. Remove both front and rear covers from the equipment shelf and all display housings in accordance with the "J" drawings, not just newly added displays. Remove all display circuit boards in accordance with the "J" drawings.

*STEPS IN PARAGRAPH 4.01.

c. Install new display wiring in accordance with Drawings T1140-B01 through T1140-B05.

d. Strap the positions on the scanning lockout switches for display positions added by following the procedures of steps (t) thru (z).*

e. Check additions or changes to display connections by following the procedures of steps (gg) thru (zz).*

f. Follow the procedures of steps (tt) and (uu)*, in reinstalling the circuit boards and checking the system for proper operation.

CALIBRATION STANDARD

5.08 If system expansion involves the addition of the calibration standard, TTI 1140A-2 List 4, proceed as follows:

a. Wire level/frequency and noise input channel 10 in accordance with Drawings T1140-B01 Sheets 1 and 2, T1140-B03 Note 53, and T1140-B05, Figure 4.

b. Perform the procedures in steps (ww) thru (yy).*

6. SELECTIVE BLANKING AND CROSS-CONNECTING POSITIONS

6.01 Since the BCD-output positions at the TTI 1140 UTMS supply BCD information to all digital displays in parallel, a means to control each individual digital display is provided. Selective blanking by strapping is the method for controlling each of the digital displays connected.

NOTE

There are in fact two ways to cause a display to blank. These are out-of-range blanking (OOR) and selective blanking (sel. blanking). This discussion is, however, only concerned with selective blanking since OOR blanking merely indicates that the input signal is beyond the system measurement capability.

*STEPS IN PARAGRAPH 4.01.

6.02 To completely understand the selective blanking options, it is imperative to know the function of the three blanking (BLNKING) terminals in each strapping position. These terminals, COMM (common), UNBLANK, and BLANK, are shown in Figure 4-8 and function as follows:

a. The COMM terminal, otherwise known as the selective blanking line, is wired to its corresponding display. A high (+5 Vdc) on the COMM terminal causes its display to blank or turn-off. A low (grd) on the COMM terminal causes its display to unblank, or turn-on when an in-range signal is present. These control voltages are obtained by strapping the COMM terminal to its associated BLANK or UNBLANK terminal.

b. The UNBLANK terminal is hard wired to the strapping circuit board ground bus. When the UNBLANK terminal is strapped to the COMM terminal, a constant ground is routed to the display, holding the display unblanked, and the display provides a reading whenever an in-range measurement is made.

c. The BLANK terminal is connected to logic on the line selector circuit board. When the corresponding input channel is not selected, a high (+5 Vdc) is supplied to the BLANK terminal. When the corresponding input channel is selected, a low (grd) is supplied to the BLANK terminal. Strapping the BLANK terminal to the COMM terminal results in its display being blanked (turned off) when the input channel is not selected or unblanked (turned on) when the input channel is selected, and an in-range signal is being measured.

6.03 Figure 4-8 shows the four types of strapping options that can be accommodated by the TTI 1140 UTMS strapping circuit boards. Each of the ten strapping positions can accommodate any of the four strapping options. For convenience, Figure 4-8 shows each of the four options connected to adjacent strapping circuit board positions. From left to right, these are:

1. Unblanked operation.
2. Three displays operating blanked from one input position.
3. One display operating blanked from three input positions.
4. Three displays operating blanked from three input positions.

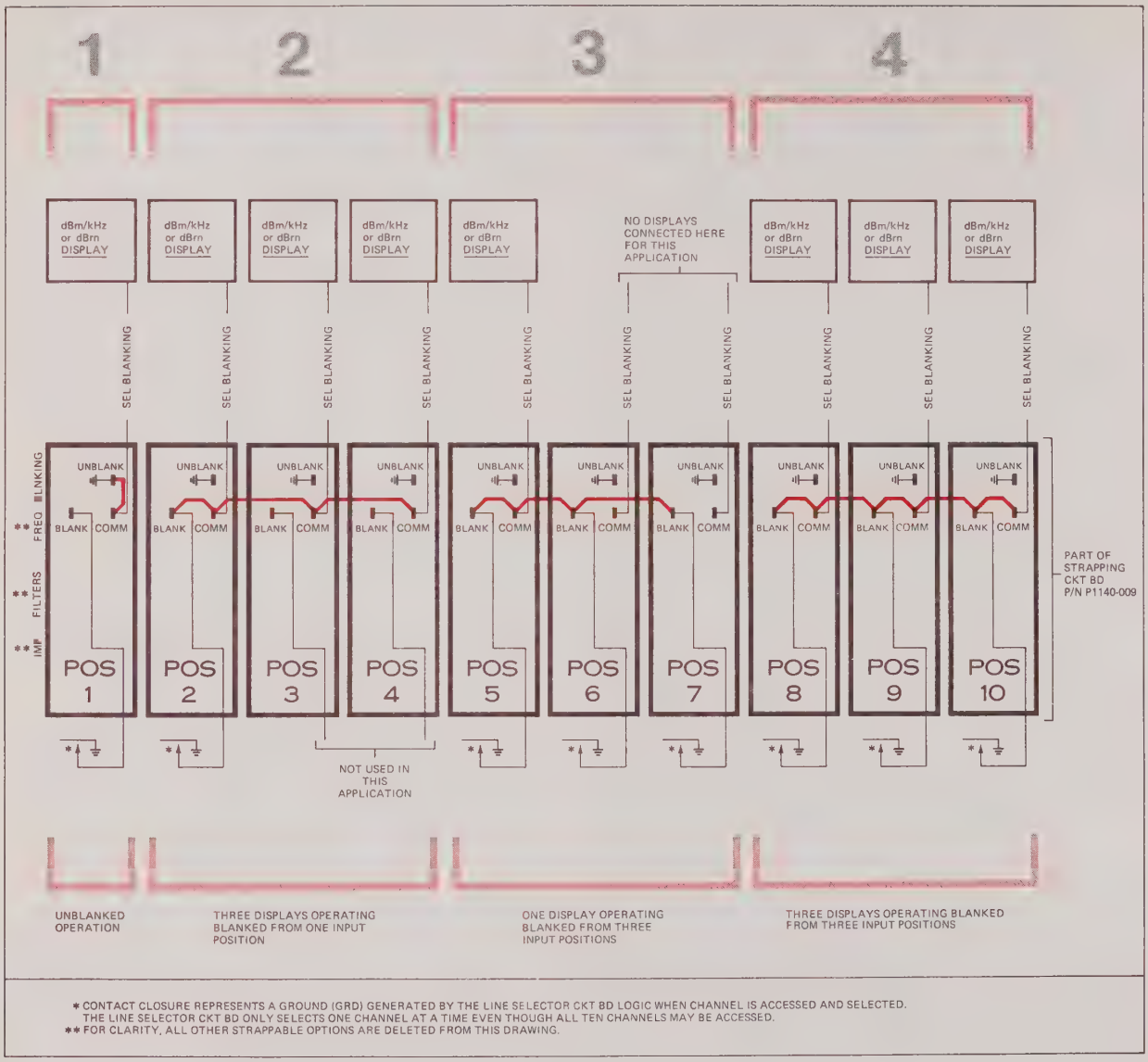

1
2
3
4
dBm/kHz or dBrn DISPLAY
NO DISPLAYS CONNECTED HERE FOR THIS APPLICATION
SEL BLANKING
** FREQ BLNKING
** FILTERS
** IMP
UNBLANK
BLANK
COMM
POS 1
POS 2
POS 3
POS 4
POS 5
POS 6
POS 7
POS 8
POS 9
POS 10
PART OF STRAPPING CKT BD P/N P1140-009
NOT USED IN THIS APPLICATION
UNBLANKED OPERATION
THREE DISPLAYS OPERATING BLANKED FROM ONE INPUT POSITION
ONE DISPLAY OPERATING BLANKED FROM THREE INPUT POSITIONS
THREE DISPLAYS OPERATING BLANKED FROM THREE INPUT POSITIONS
* CONTACT CLOSURE REPRESENTS A GROUND (GRD) GENERATED BY THE LINE SELECTOR CKT BD LOGIC WHEN CHANNEL IS ACCESSED AND SELECTED. THE LINE SELECTOR CKT BD ONLY SELECTS ONE CHANNEL AT A TIME EVEN THOUGH ALL TEN CHANNELS MAY BE ACCESSED.
** FOR CLARITY, ALL OTHER STRAPPABLE OPTIONS ARE DELETED FROM THIS DRAWING.

Figure 4-8. Selective Blanking and Cross-Connecting Positions.

SHEET INDEX

CONTENTS	SHEET NO.	REPRINT NO.									
		1	2	3	4	5	6	7	8	9	10
1. "J" DRAWING INDEX	001, SH1	-01	-02	-03							
2. ORDERING INFORMATION	001, SH2	-04	-05	-06							
3. ORDERING INFORMATION	001, SH3	-04	-04	-04							
4. EQUIPMENT SHELF TTI 1140A-2 LIST 1, OUTLINE DRAWING	002, SH1	-04	-05	-05							
5. EQUIPMENT SHELF TTI 1140A-2 LIST 1, OUTLINE DRAWING	002, SH2	-04	-05	-06							
6. AISLE MOUNT DISPLAY TTI 1140A-2 LIST 9, OUTLINE DRAWING	003	-04	-05	-05							
7. RACK MOUNT DISPLAY TTI 1140A-2 LIST 8, OUTLINE DRAWING	004	-03	-04	-04							
8. HORIZONTAL PANEL MOUNT DISPLAY TTI 1140A-2 LIST 10 AND TTI 1140A-2 LIST 13, OUTLINE DRAWING	007	-03	-04	-05							
9. VERTICAL PANEL MOUNT DISPLAY TTI 1140A-2 LIST 12, OUTLINE DRAWING	008	-01	-02	-02							

ISSUE INFORMATION

ISSUE	ECO NO.	DATE
-01	183	1/22/73
-02	265	7/2/73
-03	292	10/31/73

SHEET INDEX NOTES

1. WHEN CHANGES ARE MADE IN THIS DRAWING, ONLY THOSE SHEETS AFFECTED WILL BE REISSUED.
2. THIS SHEET INDEX WILL BE REISSUED AND BROUGHT UP TO DATE EACH TIME ANY SHEET OF THE DRAWING IS REISSUED, OR A NEW SHEET IS ADDED.
3. THE ISSUE NUMBER ASSIGNED TO A CHANGED OR NEW SHEET WILL BE THE SAME ISSUE NUMBER AS THAT OF THE REPRINT ISSUE NUMBER ABOVE.
4. SHEETS THAT ARE NOT CHANGED WILL RETAIN THEIR EXISTING ISSUE NUMBER.
5. THE LAST ISSUE NUMBER OF THE SHEET INDEX IS RECOGNIZED AS THE LATEST ISSUE NUMBER OF THE DRAWING AS A WHOLE.

SUPPORTING INFORMATION

CATEGORY	NO.
1. INTERCONNECT SCHEMATICS, CABLE ASSEMBLY DRAWINGS	S1140-A01 (INDEX)
2. CABLING DIAGRAMS	T1140-A01 (INDEX)

TTi 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

DRAWING TITLE:			DRAWN BY:
"J" DRAWING INDEX			B.G.
			CHECKED BY: D.G.L.
DRAWING NUMBER: J1140-001	ISSUE: -03	SHEET: 1 OF 3	RELEASED BY: D.R.S.

STOCK LIST

AB LIST	AC QTY PER LIST	AD EQUIPMENT CODE	AE DESCRIPTION	AF* NOTE	AG** NOTE	SHOP	INSTALLATION
1	1	TTI 1140A-2	EQUIPMENT SHELF	1	52		X
3	1	TTI 1140A-2	SCANNING LOCKOUT SWITCH	1	53		
4	1	TTI 1140A-2	CALIBRATION STANDARD	1	54		
5	1	TTI 1140A-2	-48 VDC POWER SUPPLY	1			
7	1	TTI 1140A-2	115 VAC POWER SUPPLY	1			
8	1	TTI 1140A-2	DISPLAY HOUSING, RACK MOUNT	1	55		
9	1	TTI 1140A-2	DISPLAY HOUSING, AISLE MOUNT	1	55		
10	1	TTI 1140A-2	DISPLAY HOUSING, HORIZONTAL PANEL MOUNT (2" HEIGHT)	1	55		
12	1	TTI 1140A-2	DISPLAY HOUSING, VERTICAL PANEL MOUNT	1	55		
13	1	TTI 1140A-2	DISPLAY HOUSING, HORIZONTAL PANEL MOUNT (1¾" HEIGHT)	1	55		
1	1	TTI 1140B-2	LEVEL MEASURING UNIT	1	56		
3	1	TTI 1140B-2	DISPLAY PCB, SMALL LEVEL	1	[illegible]		
4	1	TTI 1140B-2	DISPLAY PCB, LARGE LEVEL	1	58		
1	1	TTI 1140C-2	FREQUENCY MEASURING UNIT	1	58		
2	1	TTI 1140C-2	DISPLAY PCB, SMALL FREQUENCY	1	58		
3	1	TTI 1140C-2	DISPLAY PCB, LARGE FREQUENCY	1	58		
1	1	TTI 1140D-2	NOISE MEASURING UNIT	1	56		
2	1	TTI 1140D-2	C-MESSAGE FILTER (STANDARD)	1	57		
3	1	TTI 1140D-2	3 kHz FLAT FILTER (OPTIONAL)	1	57		
4	1	TTI 1140D-2	PROGRAM FILTER (OPTIONAL)	1	57		
5	1	TTI 1140D-2	15 kHz PROGRAM FILTER (OPTIONAL)	1	57		
6	1	TTI 1140D-2	50 kb/s DATA FILTER (OPTIONAL)	1	57		
7	1	TTI 1140D-2	DISPLAY PCB, SMALL NOISE	1	58		
8	1	TTI 1140D-2	DISPLAY PCB, LARGE NOISE	1	58		

*MANUFACTURING NOTE
**ENGINEERING NOTE

MANUFACTURING NOTE

1. ALL PARTS ARE ASSEMBLED FOR SHIPMENT

TABLE A

CDL	A EQUIPMENT		B LIST	C QTY USED PER SYSTEM	D REFERENCE DRAWING	E** NOTE
1140A	COMMON EQUIPMENT TTI 1140A	EQUIPMENT SHELF FOR LEVEL FREQUENCY AND NOISE MEASURING UNITS, SCANNING LOCKOUT SWITCHES, CALIBRATION STANDARD AND POWER SUPPLY	1	1	J1140-002 SHEET 1 AND 2	52
		SCANNING LOCKOUT SWITCH REQUIRED IN ADDITION TO LIST 1 IF CONTROLLED ACCESS TO LEVEL/FREQUENCY AND NOISE MEASURING UNITS IS REQUIRED	3	2	J1140-002 SHEET 2	53
		CALIBRATION STANDARD, REQUIRED IN ADDITION TO LIST 1 AND LIST 3 IF INTERNAL CALIBRATION CHECK CAPABILITY IS REQUIRED	4	1	J1140-002 SHEET 2	54
		POWER SUPPLY ONE POWER SUPPLY IS REQUIRED FOR EACH LIST 1. -48 VDC POWER SUPPLY	5	1	J1140-002 SHEET 2	
		115 VAC POWER SUPPLY	7	1	J1140-002 SHEET 2	
		RACK MOUNTED DISPLAY HOUSING USED WHERE A DISPLAY MOUNTED TO A RACK UPRIGHT IS REQUIRED	8	UP TO 10	J1140-004 SHEET 1	
		AISLE MOUNTED DISPLAY HOUSING USED IN ADDITION TO LIST 1 AT EACH LOCATION WHERE A LARGE AISLE MOUNTED DISPLAY IS REQUIRED (2" HEIGHT)	9	UP TO 10	J1140-003 SHEET 1	55
		HORIZONTAL PANEL MOUNTED DISPLAY HOUSING USED IN ADDITION TO LIST 1 AT EACH LOCATION WHERE A FLUSH, LEFT TO RIGHT DISPLAY IS REQUIRED	10	UP TO 10	J1140-007 SHEET 1	55
		VERTICAL PANEL MOUNTED DISPLAY HOUSING USED IN ADDITION TO LIST 1 AT EACH LOCATION WHERE A FLUSH, TOP TO BOTTOM, DISPLAY IS REQUIRED	12	UP TO 10	J1140-008 SHEET 1	55
		HORIZONTAL PANEL MOUNTED DISPLAY HOUSING USED WHERE A FLUSH LEFT TO RIGHT DISPLAY IS REQUIRED (1¾" HEIGHT)	13	UP TO 10	J1140-007 SHEET 1	55
1140B	LEVEL MEASURING UNIT AND LEVEL DISPLAY CIRCUIT BOARDS TTI 1140B	LEVEL MEASURING UNIT CONSISTING OF ONE EACH DIGITAL CIRCUIT BOARD, FILTER CIRCUIT BOARD, ANALOG CIRCUIT BOARD, AND DC REGULATOR CIRCUIT BOARD	1	1	J1140-002 SHEET 2	56
		LEVEL DISPLAY CIRCUIT BOARD (SMALL) USED IN 1140A LIST 8, 1140A LIST 10, AND 1140A LIST 12 DISPLAY HOUSINGS WHERE LEVEL (dBm) DISPLAY IS REQUIRED	3	UP TO 10	J1140-004, 007, 008 SHEET 1	56
		LEVEL DISPLAY CIRCUIT BOARD (LARGE) USED IN 1140A LIST 9 DISPLAY HOUSING WHERE LEVEL (dBm) DISPLAY IS REQUIRED	4	UP TO 10	J1140-003 SHEET 1	56
1140C	FREQUENCY MEASURING UNIT AND FREQUENCY DISPLAY CIRCUIT BOARDS TTI 1140C	FREQUENCY MEASURING UNIT, CONSISTING OF ONE EACH FREQUENCY COUNTER CIRCUIT BOARD REQUIRES LEVEL MEASURING UNIT TTI 1140B-1	1	1	J1140-002 SHEET 2	56
		FREQUENCY DISPLAY CIRCUIT BOARD (SMALL) USED IN 1140A LIST 8, 1140A LIST 10, AND 1140A LIST 12 DISPLAY HOUSINGS WHERE FREQUENCY (kHz) DISPLAY IS REQUIRED	2	UP TO 10	J1140-004, 007, 008 SHEET 1	56
		FREQUENCY DISPLAY CIRCUIT BOARD (LARGE) USED IN 1140A LIST 9 DISPLAY WHERE FREQUENCY (kHz) DISPLAY IS REQUIRED	3	UP TO 10	J1140-003 SHEET 1	56
1140D	NOISE MEASURING UNIT, NOISE WEIGHTING FILTERS, AND NOISE DISPLAY CIRCUIT BOARDS TTI 1140D	NOISE MEASURING UNIT, CONSISTING OF ONE EACH ANALOG CIRCUIT BOARD, FILTER CIRCUIT BOARD, DIGITAL CIRCUIT BOARD, AND DC REGULATOR CIRCUIT BOARD	1	1	J1140-002 SHEET 2	56
		OPTIONAL BAND LIMITING FILTERS FOR WEIGHTED NOISE MEASUREMENTS, REQUIRED IN ADDITION TO LIST 1, UP TO THREE FILTERS MAY BE INSTALLED ON FILTER CIRCUIT BOARD OF LIST 1. C-MESSAGE MEASUREMENTS	2	1	J1140-002 SHEET 2	57
		3-kHz FLAT MEASUREMENTS	3	1		
		PROGRAM CHANNEL MEASUREMENTS	4	1		
		15-kHz FLAT PROGRAM CHANNEL MEASUREMENTS	5	1		
		50-Kb/s DATA MEASUREMENTS	6	1		
		NOISE DISPLAY CIRCUIT BOARD (SMALL) USED IN 1140A LIST 8, 1140A LIST 10, AND 1140A LIST 12 DISPLAY HOUSINGS WHERE NOISE (dBrn) DISPLAY IS REQUIRED	7	UP TO 10	J1140-004, 007, 008 SHEET 1	58
		NOISE DISPLAY CIRCUIT BOARD (LARGE) USED IN LIST 9 DISPLAY HOUSING WHERE NOISE (dBrn) DISPLAY IS REQUIRED.	8	UP TO 10	J1140-003 SHEET 1	58

ENGINEERING NOTES

51

52 TTI 1140A 2 LIST 1 IS THE EQUIPMENT SHELF ONLY. MEASURING UNITS, POWER SUPPLY, SCANNING LOCKOUT SWITCHES, AND CALIBRATION STANDARD MUST BE ORDERED IN ADDITION TO THE EQUIPMENT SHELF (SEE MANUFACTURING NOTE 1)

53 TTI 1140A-2 LIST 3, SCANNING LOCKOUT SWITCHES, CONSIST OF TWO CIRCUIT BOARDS EACH. IF SPARE CIRCUIT BOARDS ARE REQUIRED, REFER TO DRAWING J1140-002 SHEET 2 FOR TTI PART NUMBERS (P1140-___)

A SEPARATE SCANNING LOCKOUT SWITCH IS REQUIRED FOR BOTH THE NOISE AND LEVEL/FREQUENCY MEASURING UNITS (ONE SCANNING LOCKOUT SWITCH IS USED FOR BOTH LEVEL AND FREQUENCY), AND CONTROLS THE INPUT TO THE MEASURING UNIT, ALLOWING UP TO TEN CHANNELS TO ACCESS AT ONE TIME

WHEN SCANNING LOCKOUT SWITCHES ARE NOT ORDERED, SUBSTITUTE CIRCUIT BOARDS ARE INSTALLED IN THE EQUIPMENT SHELF. THE SUBSTITUTE CIRCUIT BOARD PART NUMBERS ARE LINE SELECTOR SUBSTITUTE P1140-013, AND STRAPPING SUBSTITUTE P1140-014. WHEN THE SUBSTITUTE CIRCUIT BOARDS ARE USED, THE INPUTS ARE MULTIPLED THUS ONLY ONE NOISE CHANNEL AND ONE LEVEL/FREQUENCY CHANNEL MUST BE ACCESSED AT ONE TIME

WHEN TTI 1140A 2 LIST 4 CALIBRATION STANDARD IS ORDERED, THE EQUIPMENT SHELF REQUIRES SCANNING LOCKOUT SWITCHES TTI 1140A 2 LIST 3

54 TTI 1140A-2 LIST 4 CALIBRATION STANDARD OPTION REQUIRES SCANNING LOCKOUT SWITCHES TTI 1140A 2 LIST 3. THE CALIBRATION STANDARD IS ACCESSED AT THE EQUIPMENT SHELF INPUT CHANNEL 10 AND OPERATES WITH THE SCANNING LOCKOUT SWITCHES TO PROVIDE SEPARATE OUTPUTS FOR CALIBRATING THE NOISE AND LEVEL/FREQUENCY MEASURING UNITS

55 TTI 1140A 2 LIST 9 DISPLAY HOUSING WILL ACCOMMODATE ONE EACH LEVEL DISPLAY CIRCUIT BOARD TTI 1140B 2 LIST 4, FREQUENCY DISPLAY CIRCUIT BOARD TTI 1140C-2 LIST 3, AND NOISE DISPLAY CIRCUIT BOARD TTI 1140D 2 LIST 8. TTI 1140A-2 LIST 8, LIST 10, 12 AND LIST 13 DISPLAY HOUSINGS, WILL ACCOMMODATE ONE EACH LEVEL DISPLAY CIRCUIT BOARD TTI 1140B 2 LIST 3, FREQUENCY DISPLAY CIRCUIT BOARD TTI 1140C-2 LIST 2, AND NOISE DISPLAY CIRCUIT BOARD TTI 1140D 2 LIST 7

56 TTI 1140B-2 LIST 1 LEVEL MEASURING UNIT CONSISTS OF FOUR CIRCUIT BOARDS

TTI 1140C-2 LIST 1 FREQUENCY MEASURING UNIT CONSISTS OF A SINGLE CIRCUIT BOARD, HOWEVER, THE LEVEL MEASURING UNIT TTI 1140B-2 LIST 1 IS REQUIRED

TTI 1140D-2 LIST 1 NOISE MEASURING UNIT CONSISTS OF FOUR CIRCUIT BOARDS

IF SPARE CIRCUIT BOARDS ARE REQUIRED, REFER TO DRAWING J1140-002 SHEET 2 FOR TTI PART NUMBERS (P1140-___)

57 TTI 1140B-2 LIST 1 LEVEL MEASURING UNIT FILTER CIRCUIT BOARD CAN ACCOMMODATE ONE OPTIONAL FILTER. (TO BE ANNOUNCED)

TTI 1140D-2 LIST 1 NOISE MEASURING UNIT FILTER CIRCUIT BOARD ACCOMMODATES AS STANDARD THE C-MESSAGE AND 3-kHz FLAT WEIGHTING NETWORKS AND MAY ACCOMMODATE ONE OPTIONAL FILTER: PROGRAM, 15-kHz FLAT, OR THE 50-kb/sec DATA, WEIGHTING NETWORKS

ADDITIONAL FILTERS WILL BE ANNOUNCED AS THEY BECOME AVAILABLE

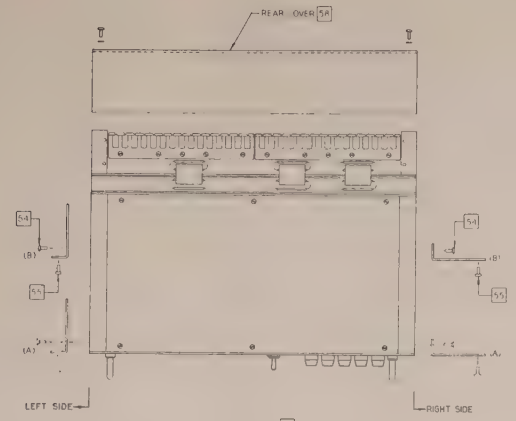
58 TTI 1140B-2 LIST 1 LEVEL MEASURING TTI 1140C-2 LIST 1 FREQUENCY MEASURING UNIT, AND TTI 1140D-2 LIST 1 NOISE MEASURING UNIT ARE CAPABLE OF DRIVING UP TO TEN (10) OF THE CORRESPONDING DISPLAY CIRCUIT BOARDS

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

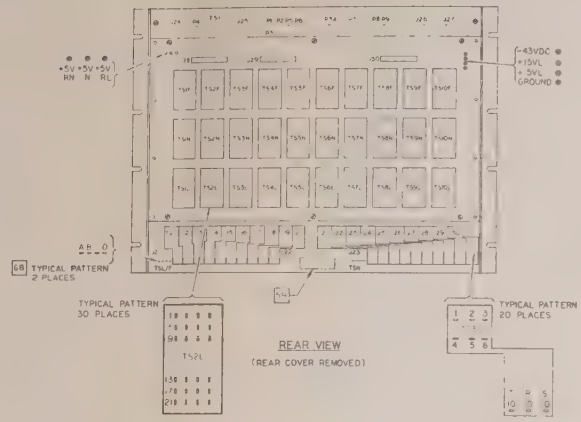
DRAWING TITLE:	DRAWN BY
ORDERING INFORMATION	B.G
	CHECKED BY: D.G.L.
DRAWING NUMBER: J1140-001 ISSUE: -06 SHEET: 2 OF 3	RELEASED BY: D.R.S.

CUSTOMER INSTALLATION NOTES AND COMMENTS

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM			
DRAWING TITLE: ORDERING INFORMATION			DRAWN BY: B G
			CHECKED BY: D.G.L.
DRAWING NUMBER: J1140-001	ISSUE: -04	SHEET: 3 OF 3	RELEASED BY: D.R.S



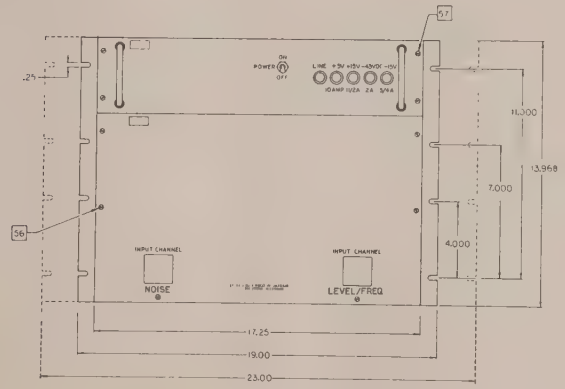
TOP VIEW 53



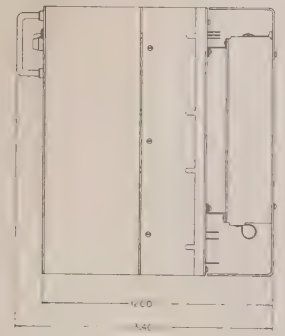
REAR VIEW
(REAR COVER REMOVED)

CAUTION

PIN 21 – (GRD)
PIN 22 – (+5 VDC)
PIN 23 – (+15 VDC)
PIN 24 – (–43 VDC OR +170 VDC)



FRONT VIEW 52



SIDE VIEW

ENGINEERING NOTES

51

52 LOCATION OF EQUIPMENT SHELF TO BE DETERMINED AND SPECIFIED BY ENGINEER/CUSTOMER

53 MOUNTING EARS CAN BE ROTATED FOR ADAPTION TO 19" OR 23" EQUIPMENT RACK. BOTH EARS MUST BE ROTATED IDENTICALLY

54 TO ATTACH MOUNTING EARS TO EQUIPMENT SHELF, FIND MOUNTING EARS AND MOUNTING HARDWARE PACKET AT THE TOP OF INNER CONTAINER. PLACE THE MOUNTING EARS IN LOCATION (A) FLUSH OR (B) EXTENDED AND ROTATE TO MATCH EQUIPMENT RACK WIDTH (NOTE 53). SECURE EARS TO EQUIPMENT SHELF USING 6-32X3/8" FLAT HEAD SCREWS (6 PLACES) FOR 19" ADAPTION. SECURE EARS TO EQUIPMENT SHELF USING 6-32X3/8" BINDER HEAD SCREWS (6 PLACES) FOR 23" ADAPTION

55 TO ATTACH EQUIPMENT SHELF TO EQUIPMENT RACK, USE 12-24X1/2" BINDER HEAD SCREWS (8 PLACES)

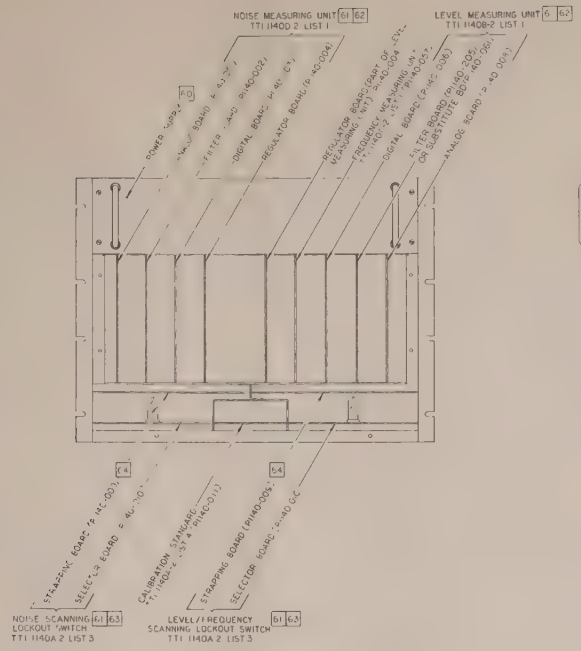
56 TO REMOVE FRONT COVER, REMOVE 6-32X3/8" SCREWS (6 PLACES)

57 TO REMOVE POWER SUPPLY, REMOVE 6-32X3/8" SCREWS (4 PLACES). REMOVE BRAIDED GROUND STRAP AT TOP-REAR OF POWER SUPPLY BY REMOVING 6-32X3/8" SCREW (1 PLACE)

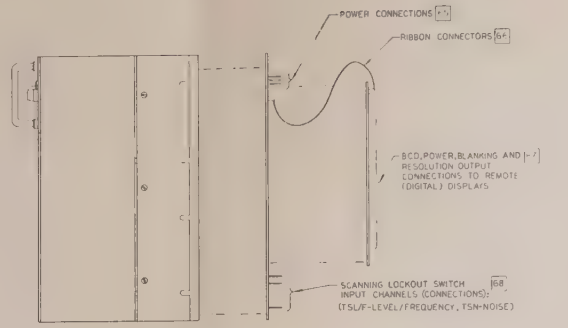
58 TO REMOVE REAR COVER, REMOVE 6-32X3/8" SCREWS (4 PLACES)

59 EQUIPMENT REVISION/IDENTIFICATION NUMBER. THE EIGHT DIGIT NUMBER MUST BE USED TO IDENTIFY THE EQUIPMENT FOR ORDERING AND MAINTENANCE PURPOSES. THE NUMBER WILL ALSO ALLOW CROSS REFERENCE TO APPLICABLE DOCUMENTATION

TTi	1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM		
DRAWING TITLE: OUTLINE DRAWING, EQUIPMENT SHELF TTI 1140A-2 LIST 1			DRAWN BY: BG
			CHECKED BY: DGL
DRAWING NUMBER: J1140-002	ISSUE: -05	SHEET: 1 OF 2	RELEASED BY: DRS.


NOISE MEASURING UNIT 61 62
TTI 1140D-2 LIST 1
LEVEL MEASURING UNIT 61 62
TTI 1140B-2 LIST 1
POWER SUPPLY
INTERFACE BOARD (P/O 40-0041)
DIGITAL BOARD (P/O 40-0002)
REGULATOR BOARD (P/O 40-0041)
REGULATOR BOARD (PART OF "FREQUENCY MEASURING UNIT" TTI 1140D-2 LIST 1 P/O 40-0041)
DIGITAL BOARD (P/O 40-0002)
A/D CONVERTER BOARD (P/O 40-0041) OR SUBSTITUTE BOARD (P/O 40-0061)
ANALOG BOARD (P/O 40-0001)
64
64
STRAPPING BOARD (P/O 40-0005)
SELECTOR BOARD (P/O 40-0006)
CALIBRATION STANDARD TTI 1140D-2 LIST 4 (P/O 40-0011)
NOISE SCANNING LOCKOUT SWITCH 61 63
TTI 1140A-2 LIST 3
LEVEL/FREQUENCY SCANNING LOCKOUT SWITCH 61 63
TTI 1140A-2 LIST 3

FRONT VIEW
(COVER REMOVED)


POWER CONNECTIONS 67
RIBBON CONNECTORS 66
BCD, POWER, BLANKING AND RESOLUTION OUTPUT CONNECTIONS TO REMOTE (DIGITAL) DISPLAYS
SCANNING LOCKOUT SWITCH 68
INPUT CHANNELS (CONNECTIONS):
(TSL/F-LEVEL/FREQUENCY, TSN-NOISE)

EXPLODED SIDE VIEW

ENGINEERING NOTES

60 EQUIPMENT SHELF CAN BE EQUIPPED WITH ONE OF THE FOLLOWING POWER SUPPLIES
A. –48 VDC TTI 1140A-2 LIST 5
B 115 VAC TTI 1140A-2 LIST 7

61 TO EXTRACT CIRCUIT BOARDS, REMOVE 6-32X3/8" SCREWS (6 PLACES) FROM FRONT COVER. INSERT EXTRACTOR TOOL, LOCATED IN THE EQUIPMENT SHELF, INTO HOLE LOCATED AT THE FRONT-CENTER OF EACH CIRCUIT BOARD GENTLY PULL CIRCUIT BOARDS STRAIGHT OUT. IF EXTRACTOR TOOL IS NOT USED, DO NOT PUT PRESSURE ON NIXIE TUBES OR CIRCUIT COMPONENTS AS DAMAGE MAY RESULT

62 TO INSERT CIRCUIT BOARDS, ELECTRONIC COMPONENTS MUST BE FACING TO THE RIGHT.

63 TO INSERT CIRCUIT BOARDS, ELECTRONIC COMPONENTS MUST BE FACING UP.

64 THE STRAPPING CIRCUIT BOARD MUST BE CORRECTLY STRAPPED PRIOR TO PLACING SYSTEM INTO OPERATION (REFERENCE INSTALLATION INSTRUCTIONS)

65 SEE TABLE A

66 SEE TABLE B

67 SEE TABLE C

68 SEE TABLE D.

TABLE A
POWER INPUT TERMINALS

POWER SUPPLY	CONDUCTOR	PIN
115 VAC	115 VAC-HOT (BLACK)	P2
	RETURN (WHITE)	P1
	GROUND (GREEN)	P3
–48 VDC*	–48 VDC	P2
	FRAME GROUND	P1
	BRAID TO P/S	P3A

*P1 (FRAME GRD) IS SHORTED TO P3 (SYSTEM GRD)

TABLE B
RIBBON CONNECTORS

RIBBON CONNECTOR	TO BCD TERMINALS	TO DISPLAY CIRCUIT BOARD
J28	TS1L THRU TS10L	LEVEL
J29	TS1F THRU TS10F	FREQUENCY
J30	TS1N THRU TS10N	NOISE

TABLE C
BCD OUTPUT TERMINALS/DISPLAY CIRCUIT BOARD INPUT PINS

TERMINAL/PIN NUMBER	FREQUENCY kHz	NOISE dBrn	LEVEL dBm
1	D8	M8	NOT USED
2	D4 Thousands	M4 Tens	M4 Tens
3	D2 Hz	M2 dBrn	M2 dBm
4	D1	M1	M1
5	C8	L8	L8
6	C4 Hundreds	L4 Units	L4 Units
7	C2 Hz	L2 dBrn	L2 dBm
8	C1	L1	L1
9	B8	NOT USED	K8
10	B4 Tens	NOT USED	K4 Tenths
11	B2 Hz	NOT USED	K2 dBm
12	B1	NOT USED	K1
13	A8	NOT USED	NOT USED
14	A4 Units	NOT USED	NOT USED
15	A2 Hz	NOT USED	NOT USED
16	A1	NOT USED	NOT USED
17	*OOR BLANKING	*OOR BLANKING	*OOR BLANKING
18	10-Hz DECIMAL	MINUS (–)	MINUS (–)
19	1-Hz DECIMAL	PLUS (+)	PLUS (+)
20	SEL. BLANKING	SEL. BLANKING	SEL. BLANKING
21	GRD	GRD	GRD
22	+5 VDC	+5 VDC	+5 VDC
23	+15 VDC	+15 VDC	+15 VDC
24	–43VDC (FUSED)	–43VDC (FUSED)	–43VDC (FUSED)

*OOR = OUT OF RANGE

***TABLE D**
INPUT CHANNEL TERMINALS

TERMINAL NO	FUNCTION	INPUT/ OUTPUT	ACCESS JACK PIN NO
T1	TIP	INPUT	7
R1	RING	INPUT	4
S1	SLEEVE**	INPUT	SHIELD
TS11-1	–48 VDC COMMON BUS	OUTPUT	6
TS11 2	NOT USED	NOT USED	NO CONN
TS11-3	GROUND COMMON BUS	OUTPUT	2
TS11-4	LAMP/RELAY BATTERY COMMON BUS	INPUT	5
TS11-5	LINE SELECTOR CONTROL	INPUT	3
TS11-6	LAMP/RELAY RETURN	RETURN	BUSY CIRCUIT
A	LINE SELECTOR POSITION, BCD 1	OUTPUT	NO CONN
B	LINE SELECTOR POSITION, BCD 2	OUTPUT	NO CONN
C	LINE SELECTOR POSITION, BCD 4	OUTPUT	NO. CONN
D	LINE SELECTOR POSITION, BCD 8	OUTPUT	NO. CONN.

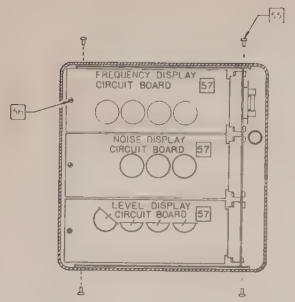
*LEVEL/FREQUENCY CHANNEL 1 SHOWN
**DO NOT CONNECT TO PIN 1 ON JACK (JACK TERMINAL SLEEVE)

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

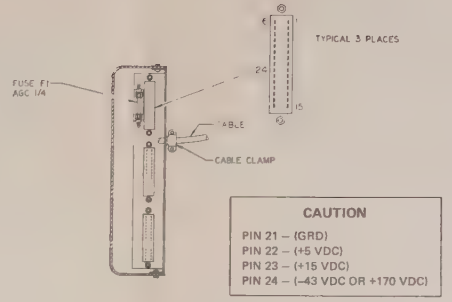
DRAWING TITLE: OUTLINE DRAWING, EQUIPMENT SHELF TTI 1140A-2 LIST 1

DRAWN BY: B.G
CHECKED BY: D.G.L
RELEASED BY: D.R.S

DRAWING NUMBER: J1140-002 | ISSUE: -06 | SHEET: 2 OF 2



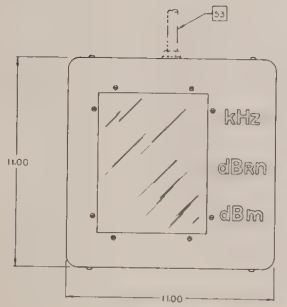
INTERNAL FRONT VIEW



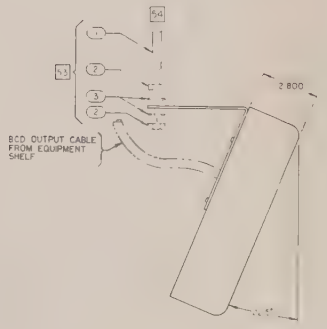
CAUTION

PIN 21 – (GRD)
PIN 22 – (+5 VDC)
PIN 23 – (+15 VDC)
PIN 24 – (–43 VDC OR +170 VDC)

INTERNAL SIDE VIEW



FRONT VIEW 52



SIDE VIEW

ENGINEERING NOTES

51

52 LOCATION OF DISPLAY AND DESIGNATION OF POSITION TO BE DETERMINED AND SPECIFIED BY ENGINEER/CUSTOMER

53 LENGTH OF ROD AND DISPLAY MOUNTING HARDWARE TO BE DETERMINED AND SPECIFIED BY ENGINEER/CUSTOMER (SEE TABLE A FOR TYPICAL MOUNTING EQUIPMENT) NINE FEET IS THE RECOMMENDED MINIMUM HEIGHT ABOVE FLOOR

54 UPPER FRAME MOUNTING HARDWARE TO BE SPECIFIED BY ENGINEER/CUSTOMER

55 TO REMOVE FRONT COVER, REMOVE 6-32X3/8" BLACK SCREWS (4 PLACES)

56 TO EXTRACT CIRCUIT BOARDS, REMOVE 6-32X5/16" SCREW AND #6 INTERNAL LOCK WASHER FROM EACH CIRCUIT BOARD (1 PLACE). FREQUENCY CIRCUIT BOARD MUST HAVE #6 FIBER WASHER BETWEEN #6 INTERNAL LOCK WASHER AND CIRCUIT BOARD

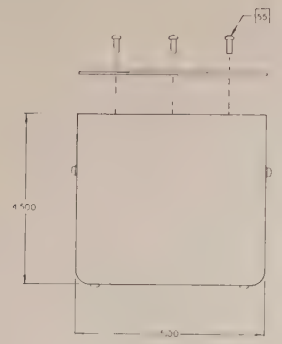
57 DISPLAY CIRCUIT BOARD PART NUMBERS/EQUIPMENT CODE NUMBERS

A. FREQUENCY	P1140-031-02/TTI 1140C-2 LIST 3
B. NOISE	P1140-029-02/TTI 1140D-2 LIST 8
C. LEVEL	P1140-030-02/TTI 1140B-2 LIST 4

TABLE A
TYPICAL MOUNTING EQUIPMENT
(NOT PROVIDED WITH DISPLAY)

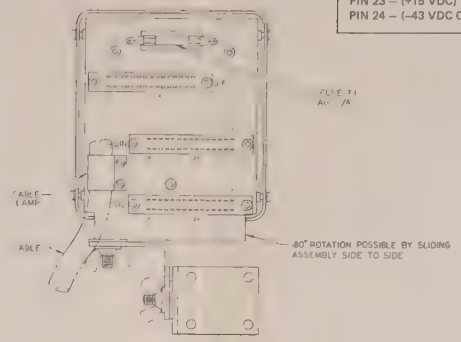
ITEM	DESCRIPTION	QTY	PART NUMBER
1	ROD, THREADED 5/8" DIA X 2'0"	1 (OR)	WECO P-68228
	ROD, THREADED 5/8" DIA X 2'6"	1 (OR)	WECO P-402572
	ROD, THREADED 5/8" DIA X 3'0"	1 (OR)	WECO P-68229
	ROD, THREADED 5/8" DIA X 4'0"	1 (OR)	WECO P-68230
	ROD, THREADED 5/8" DIA X 5'0"	1	WECO P-69107
2	NUT, HEX 5/8" X 11"	2	WECO P-205261
3	WASHER, FLAT .652 X 1.062 O D	2	

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM	
DRAWING TITLE: OUTLINE DRAWING, AISLE MOUNT DISPLAY TTI 1140A-2 LIST 9	DRAWN BY: B G
	CHECKED BY: D G L
DRAWING NUMBER: J1140-003 / ISSUE: -05 / SHEET: 1 OF 1	RELEASED BY: D.R.S

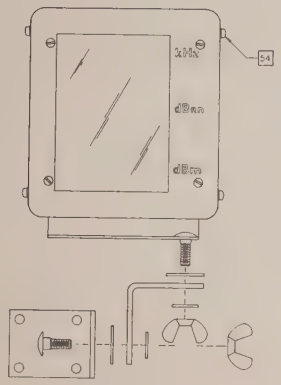


TOP VIEW
(REAR COVER REMOVED)

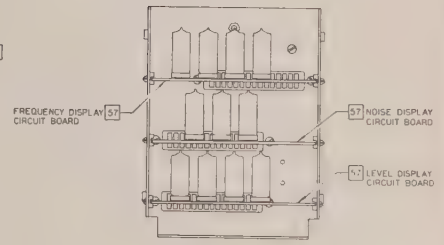
CAUTION
PIN 21 – (GRD)
PIN 22 – (+5 VDC)
PIN 23 – (+15 VDC)
PIN 24 – (–43 VDC OR +170 VDC)



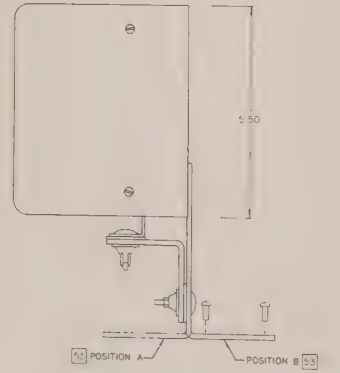
REAR VIEW (REAR COVER REMOVED)



FRONT VIEW 52



FRONT VIEW 56
(FRONT COVER REMOVED)



SIDE VIEW

ENGINEERING NOTES

51

52 LOCATION OF DISPLAY AND DESIGNATION OF POSITION TO BE DETERMINED AND SPECIFIED BY ENGINEER/CUSTOMER

53 TO ATTACH DISPLAY TO EQUIPMENT RACK UPRIGHT, ROTATE MOUNTING BRACKET FROM SHIPPING POSITION A TO MOUNTING POSITION B. FIND HARDWARE PACKET AND ATTACH DISPLAY USING 12-24X1/2" SCREWS (4 PLACES)

54 TO REMOVE FRONT COVER, REMOVE 6-32X3/8" SCREWS (4 PLACES)

55 TO REMOVE REAR COVER, REMOVE 6-32X3/8" SCREWS (3 PLACES)

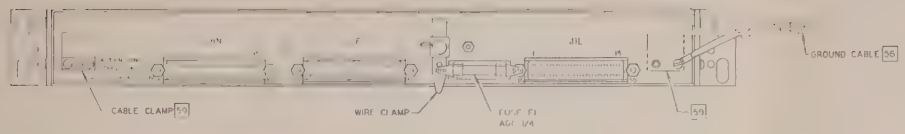
56 TO EXTRACT CIRCUIT BOARDS, REMOVE FRONT COVER (NOTE 54). INSERT EXTRACTOR TOOL, LOCATED IN THE EQUIPMENT SHELF, INTO HOLE LOCATED AT THE FRONT-CENTER OF EACH CIRCUIT BOARD. GENTLY PULL CIRCUIT BOARDS STRAIGHT OUT. IF EXTRACTOR TOOL IS NOT USED, DO NOT PUT PRESSURE ON NIXIE TUBES OR CIRCUIT COMPONENTS AS DAMAGE MAY RESULT.

57 DISPLAY CIRCUIT BOARD PART NUMBERS/EQUIPMENT CODE NUMBERS.

A. FREQUENCY	P1140-028-02/TTI 1140C-2	LIST 2
B. NOISE	P1140-026-02/TTI 1140D-2	LIST 7
C. LEVEL	P1140-027-02/TTI 1140B-2	LIST 3

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

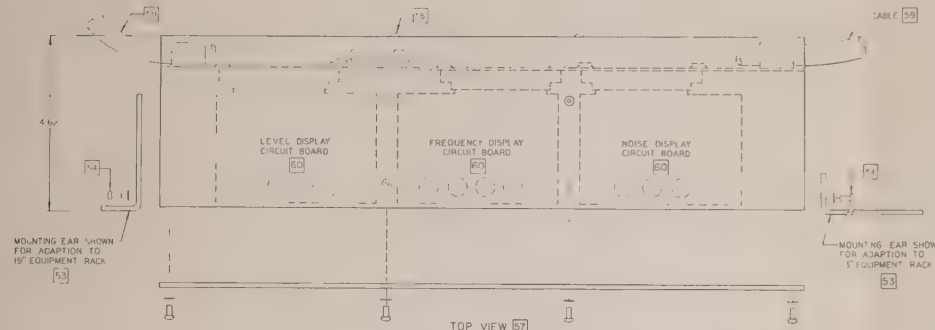
DRAWING TITLE: OUTLINE DRAWING, RACK MOUNT DISPLAY TTI 1140A-2 LIST 8			DRAWN BY: B.G
			CHECKED BY: D.G.L.
DRAWING NUMBER: J1140-004	ISSUE: -04	SHEET: 1 OF 1	RELEASED BY: D.R.S.



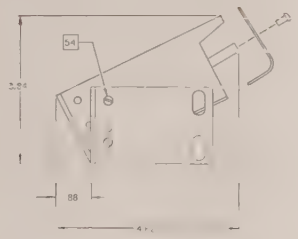
REAR VIEW

CAUTION

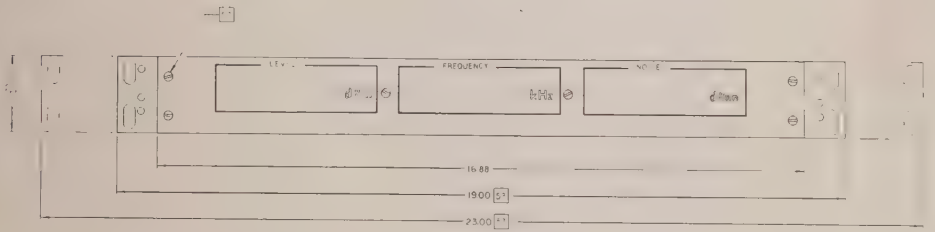
PIN 21 – (GRD)
PIN 22 – (+5 VDC)
PIN 23 – (+15 VDC)
PIN 24 – (–43 VDC OR +170 VDC)


CABLE 59
LEVEL DISPLAY CIRCUIT BOARD 60
FREQUENCY DISPLAY CIRCUIT BOARD 60
NOISE DISPLAY CIRCUIT BOARD 60
MOUNTING EAR SHOWN FOR ADAPTION TO 19" EQUIPMENT RACK 53
MOUNTING EAR SHOWN FOR ADAPTION TO 23" EQUIPMENT RACK 53

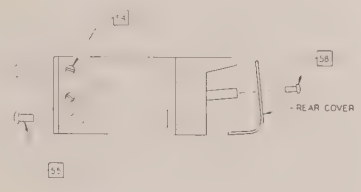
TOP VIEW 57



SIDE VIEW (TILTED APPROX 26°)



FRONT VIEW 52



SIDE VIEW (NO TILT)

ENGINEERING NOTES

51

52 LOCATION OF THE DISPLAY AND DESIGNATION OF THE POSITION TO BE DETERMINED AND SPECIFIED BY ENGINEER/CUSTOMER

53 MOUNTING EARS CAN BE ROTATED FOR ADAPTION TO 19" OR 23" EQUIPMENT RACK. BOTH EARS MUST BE ROTATED IDENTICALLY

54 TO ATTACH MOUNTING EARS TO DISPLAY HOUSING, CHOOSE CORRECT ATTITUDE (TILT OR NO TILT) AND SECURE EARS USING 8-32X3/8" SCREWS (4 PLACES).

55 TO ATTACH DISPLAY TO EQUIPMENT RACK. FIND HARDWARE PACKET AND ATTACH DISPLAY USING 12-24X1/2" SCREWS (4 PLACES). SLOTS IN MOUNTING EARS PROVIDE FOR FINE ALIGNMENT OF DISPLAY ON EQUIPMENT RACK

56 12" GROUNDING CABLE MUST BE CONNECTED TO EQUIPMENT FRAME (FRAME GROUND)

57 TO EXTRACT CIRCUIT BOARDS, REMOVE 6-32X3/8" SCREWS (6 PLACES) FROM FRONT COVER. INSERT EXTRACTOR TOOL, LOCATED IN THE EQUIPMENT SHELF, INTO HOLE LOCATED AT THE FRONT-CENTER OF EACH CIRCUIT BOARD. GENTLY PULL CIRCUIT BOARDS STRAIGHT OUT. IF EXTRACTOR TOOL IS NOT USED, DO NOT PUT PRESSURE ON NIXIE TUBES OR CIRCUIT COMPONENTS AS DAMAGE MAY RESULT

58 TO REMOVE REAR COVER, REMOVE 6-32X3/8" SCREWS (2 PLACES).

59 CABLE CLAMP MAY BE ATTACHED TO EITHER THE LEFT OR RIGHT SIDE OF DISPLAY, ALLOWING CABLE ENTRY FROM EITHER SIDE

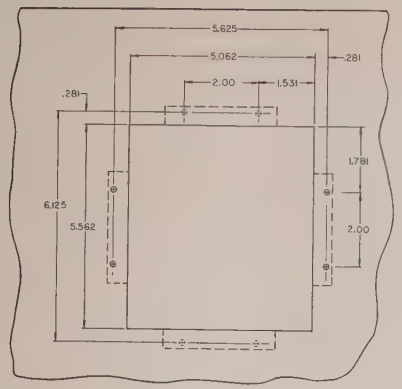
60 DISPLAY CIRCUIT BOARD PART NUMBERS/EQUIPMENT CODE NUMBERS

A. LEVEL	P1140-027-02/TTI 1140B-2 LIST 3
B. FREQUENCY	P1140-028-02/TTI 1140C-2 LIST 2
C. NOISE	P1140-026-02/TTI 1140D-2 LIST 7

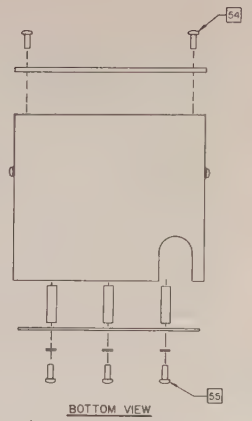
61 TTI 1140A-2 LIST 10 – 2.00"
TTI 1140A-2 LIST 13 – 1.75'

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

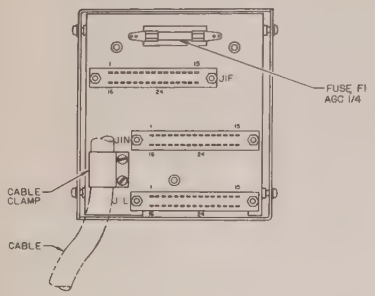
DRAWING TITLE: OUTLINE DRAWING, HORIZONTAL PANEL MOUNT DISPLAY TTI 1140A-2 LIST 10 & LIST 13			DRAWN BY: B G
			CHECKED BY: D.G.L.
DRAWING NUMBER: J1140-007	ISSUE: -05	SHEET: 1 OF 1	RELEASED BY: D.R.S



PANEL DIE CUT DIMENSIONS 53



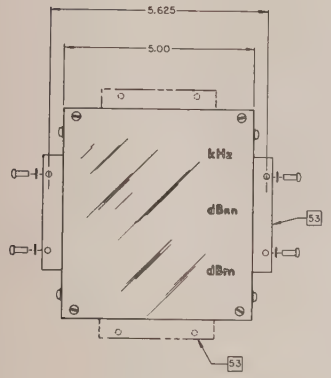
BOTTOM VIEW
(FRONT & REAR COVER REMOVED)



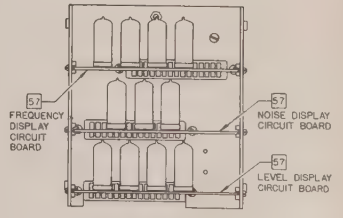
REAR VIEW (REAR COVER REMOVED)

CAUTION

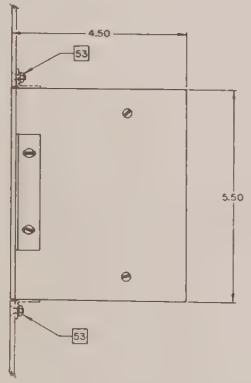
PIN 21 – (GRD)
PIN 22 – (+5 VDC)
PIN 23 – (+15 VDC)
PIN 24 – (–43 VDC OR +170 VDC)



FRONT VIEW 52



FRONT VIEW 56
(FRONT COVER REMOVED)



SIDE VIEW

ENGINEERING NOTES

51

52 LOCATION OF DISPLAY, DESIGNATION OF POSITION, AND PANEL MOUNTING PATTERN TO BE DETERMINED AND SPECIFIED BY ENGINEER/CUSTOMER

53 TO ATTACH DISPLAY TO CUSTOMER PROVIDED PANEL, PLACE BRACKETS ON DISPLAY ASSEMBLY TO MATCH PANEL STUD CONFIGURATION (TOP/BOTTOM OR SIDES), USING 6-32X1/4 SCREWS (4 PLACES). FIND HARDWARE PACKET AND ATTACH DISPLAY TO PANEL STUDS USING #6 NUTS (4 PLACES). DISPLAY MUST BE ATTACHED TO THE BACKSIDE OF PANEL, WITH FRONT COVER FLUSH WITH PANEL FRONT.

54 TO REMOVE FRONT COVER, REMOVE 4-40X1/4 BLACK SCREWS (4 PLACES)

55 TO REMOVE REAR COVER, REMOVE 6-32X1/4 SCREWS (3 PLACES)

56 TO EXTRACT CIRCUIT BOARDS, REMOVE FRONT COVER (NOTE 54). INSERT EXTRACTOR TOOL, LOCATED IN THE EQUIPMENT SHELF, INTO HOLE LOCATED AT THE FRONT-CENTER OF EACH CIRCUIT BOARD. GENTLY PULL CIRCUIT BOARDS STRAIGHT OUT. IF EXTRACTOR TOOL IS NOT USED, DO NOT PUT PRESSURE ON NIXIE TUBES OR CIRCUIT COMPONENTS AS DAMAGE MAY RESULT.

57 DISPLAY CIRCUIT BOARD PART NUMBERS/EQUIPMENT CODE NUMBERS

A. FREQUENCY	P1140-028-02/TTI 1140C-2	LIST 2
B. NOISE	P1140-026-02/TTI 1140D-2	LIST 7
C. LEVEL	P1140-027-02/TTI 1140B-2	LIST 3

TTI	1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM
DRAWING TITLE: OUTLINE DRAWING, VERTICAL PANEL MOUNT DISPLAY TTI 1140A-2 LIST 12	DRAWN BY: B.G
	CHECKED BY: D.G.L.
DRAWING NUMBER: J1140-008 / ISSUE: -02 / SHEET: 1 OF 1	RELEASED BY: D.R.S.

SHEET INDEX

CONTENTS	SHEET NO.	REPRINT NO.									
		1	2	3	4	5	6	7	8	9	10
1. "S" DRAWING INDEX	A01	-04	-05	-06							
2. INPUT WIRING TABLE	B01, SH2	-05	-05	-05							
3. INTERCONNECT SCHEMATIC, SINGLE INPUTS	B01, SH2	-05	-05	-06							
4. INTERCONNECT SCHEMATIC, MULTIPLED INPUTS	B01, SH3	-02	-02	-02							
5. CABLE ASSEMBLY DRAWING APPLICATIONS	G01	-03	-03	-03							
6. CAD 1, EQUIPMENT SHELF	G02	-05	-06	-06							
7. CAD 2 THRU CAD 8, INPUTS AND DISPLAYS	G03	-05	-06	-06							

ISSUE INFORMATION

ISSUE	ECO NO.	DATE
A	101	9/11/70
C	104	4/26/71
-04	183	1/22/73
-05	265	7/2/73
-06	292	10/31/73

SHEET INDEX NOTES

1. WHEN CHANGES ARE MADE IN THIS DRAWING, ONLY THOSE SHEETS AFFECTED WILL BE REISSUED.
2. THIS SHEET INDEX WILL BE REISSUED AND BROUGHT UP TO DATE EACH TIME ANY SHEET OF THE DRAWING IS REISSUED, OR A NEW SHEET IS ADDED.
3. THE ISSUE NUMBER ASSIGNED TO A CHANGED OR NEW SHEET WILL BE THE SAME ISSUE NUMBER AS THAT OF THE REPRINT ISSUE NUMBER ABOVE.
4. SHEETS THAT ARE NOT CHANGED WILL RETAIN THEIR EXISTING ISSUE NUMBER.
5. THE LAST ISSUE NUMBER OF THE SHEET INDEX IS RECOGNIZED AS THE LATEST ISSUE NUMBER OF THE DRAWING AS A WHOLE.

SUPPORTING INFORMATION

CATEGORY	NO.
1. EQUIPMENT OUTLINE DRAWINGS	J1140-001, SH1 (INDEX)
2. CABLING DIAGRAMS	T1140-A01 (INDEX)

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM			
DRAWING TITLE: "S" DRAWING INDEX			DRAWN BY: B.G.
			CHECKED BY: D.G.L.
DRAWING NUMBER: S1140-A01	ISSUE: -06	SHEET: 1 OF 1	RELEASED BY: D.R.S.

TABLE 1 [52]
INTERCONNECTION, JACK AND LAMP/RELAY POSITIONS TO EQUIPMENT SHELF INPUT CHANNELS

LEVEL/FREQUENCY (dBm/kHz)		
JACK AND LAMP/RELAY POSITIONS	TO	EQUIPMENT SHELF INPUT CHANNELS
POSITION 1 dBm/kHz WIRE B		CHANNEL 1 dBm/kHz TS11-6
POSITION 1 dBm/kHz PIN 1		CHANNEL 1 dBm/kHz TSL/F S1
POSITION 1 dBm/kHz PIN 2		CHANNEL 1 dBm/kHz TS11-3
POSITION 1 dBm/kHz PIN 3		CHANNEL 1 dBm/kHz TS11-5
POSITION 1 dBm/kHz PIN 4		CHANNEL 1 dBm/kHz TSL/F R1
POSITION 1 dBm/kHz PIN 5		CHANNEL 1 dBm/kHz TS11-4 WIRE A
POSITION 1 dBm/kHz PIN 6		CHANNEL 1 dBm/kHz TS11-1
POSITION 1 dBm/kHz PIN 7		CHANNEL 1 dBm/kHz TSL/F T1
POSITION 2 dBm/kHz WIRE B		CHANNEL 2 dBm/kHz TS12-6
POSITION 2 dBm/kHz PIN 1		CHANNEL 2 dBm/kHz TSL/F S2
POSITION 2 dBm/kHz PIN 2		CHANNEL 2 dBm/kHz TS12-3
POSITION 2 dBm/kHz PIN 3		CHANNEL 2 dBm/kHz TS12 5
POSITION 2 dBm/kHz PIN 4		CHANNEL 2 dBm/kHz TSL/F-R2
POSITION 2 dBm/kHz PIN 5		CHANNEL 2 dBm/kHz TS12-4, WIRE A
POSITION 2 dBm/kHz PIN 6		CHANNEL 2 dBm/kHz TS12-1
POSITION 2 dBm/kHz PIN 7		CHANNEL 2 dBm/kHz TSL/F-T2
POSITION 3 dBm/kHz WIRE B		CHANNEL 3 dBm/kHz TS13-6
POSITION 3 dBm/kHz PIN 1		CHANNEL 3 dBm/kHz TSL/F S3
POSITION 3 dBm/kHz PIN 2		CHANNEL 3 dBm/kHz TS13-3
POSITION 3 dBm/kHz PIN 3		CHANNEL 3 dBm/kHz TS13-5
POSITION 3 dBm/kHz PIN 4		CHANNEL 3 dBm/kHz TSL/F-R3
POSITION 3 dBm/kHz PIN 5		CHANNEL 3 dBm/kHz TS13-4, WIRE A
POSITION 3 dBm/kHz PIN 6		CHANNEL 3 dBm/kHz TS13-1
POSITION 3 dBm/kHz PIN 7		CHANNEL 3 dBm/kHz TSL/F-T3
POSITION 4 dBm/kHz WIRE B		CHANNEL 4 dBm/kHz TS14-6
POSITION 4 dBm/kHz PIN 1		CHANNEL 4 dBm/kHz TSL/F-S4
POSITION 4 dBm/kHz PIN 2		CHANNEL 4 dBm/kHz TS14-3
POSITION 4 dBm/kHz PIN 3		CHANNEL 4 dBm/kHz TS14-5
POSITION 4 dBm/kHz PIN 4		CHANNEL 4 dBm/kHz TSL/F R4
POSITION 4 dBm/kHz PIN 5		CHANNEL 4 dBm/kHz TS14-4, WIRE A
POSITION 4 dBm/kHz PIN 6		CHANNEL 4 dBm/kHz TS14-1
POSITION 4 dBm/kHz PIN 7		CHANNEL 4 dBm/kHz TSL/F-T4
POSITION 5 dBm/kHz WIRE B		CHANNEL 5 dBm/kHz TS15-6
POSITION 5 dBm/kHz PIN 1		CHANNEL 5 dBm/kHz TSL/F S5
POSITION 5 dBm/kHz PIN 2		CHANNEL 5 dBm/kHz TS15 3
POSITION 5 dBm/kHz PIN 3		CHANNEL 5 dBm/kHz TS15-5
POSITION 5 dBm/kHz PIN 4		CHANNEL 5 dBm/kHz TSL/F-R5
POSITION 5 dBm/kHz PIN 5		CHANNEL 5 dBm/kHz TS15-4, WIRE A
POSITION 5 dBm/kHz PIN 6		CHANNEL 5 dBm/kHz TS15-1
POSITION 5 dBm/kHz PIN 7		CHANNEL 5 dBm/kHz TSL/F-T2
POSITION 6 dBm/kHz WIRE B		CHANNEL 6 dBm/kHz TS16 6
POSITION 6 dBm/kHz PIN 1		CHANNEL 6 dBm/kHz TSL/F S6
POSITION 6 dBm/kHz PIN 2		CHANNEL 6 dBm/kHz TS16-3
POSITION 6 dBm/kHz PIN 3		CHANNEL 6 dBm/kHz TS16 5
POSITION 6 dBm/kHz PIN 4		CHANNEL 6 dBm/kHz TSL/F-R6
POSITION 6 dBm/kHz PIN 5		CHANNEL 6 dBm/kHz TS16-4, WIRE A
POSITION 6 dBm/kHz PIN 6		CHANNEL 6 dBm/kHz TS16 1
POSITION 6 dBm/kHz PIN 7		CHANNEL 6 dBm/kHz TSL/F-T5
POSITION 7 dBm/kHz WIRE B		CHANNEL 7 dBm/kHz TS17-6
POSITION 7 dBm/kHz PIN 1		CHANNEL 7 dBm/kHz TSL/F-S7
POSITION 7 dBm/kHz PIN 2		CHANNEL 7 dBm/kHz TS17-3
POSITION 7 dBm/kHz PIN 3		CHANNEL 7 dBm/kHz TS17 5
POSITION 7 dBm/kHz PIN 4		CHANNEL 7 dBm/kHz TSL/F-R7
POSITION 7 dBm/kHz PIN 5		CHANNEL 7 dBm/kHz TS17-4, WIRE A
POSITION 7 dBm/kHz PIN 6		CHANNEL 7 dBm/kHz TS17-1
POSITION 7 dBm/kHz PIN 7		CHANNEL 7 dBm/kHz TSL/F-T7
POSITION 8 dBm/kHz WIRE B		CHANNEL 8 dBm/kHz TS18 6
POSITION 8 dBm/kHz PIN 1		CHANNEL 8 dBm/kHz TSL/F S8
POSITION 8 dBm/kHz PIN 2		CHANNEL 8 dBm/kHz TS18-3
POSITION 8 dBm/kHz PIN 3		CHANNEL 8 dBm/kHz TS18 5
POSITION 8 dBm/kHz PIN 4		CHANNEL 8 dBm/kHz TSL/F-R8
POSITION 8 dBm/kHz PIN 5		CHANNEL 8 dBm/kHz TS18-4, WIRE A
POSITION 8 dBm/kHz PIN 6		CHANNEL 8 dBm/kHz TS18-1
POSITION 8 dBm/kHz PIN 7		CHANNEL 8 dBm/kHz TSL/F T8
POSITION 9 dBm/kHz WIRE B		CHANNEL 9 dBm/kHz TS19 6
POSITION 9 dBm/kHz PIN 1		CHANNEL 9 dBm/kHz TSL/F S9
POSITION 9 dBm/kHz PIN 2		CHANNEL 9 dBm/kHz TS19-3
POSITION 9 dBm/kHz PIN 3		CHANNEL 9 dBm/kHz TS19 5
POSITION 9 dBm/kHz PIN 4		CHANNEL 9 dBm/kHz TSL/F R9
POSITION 9 dBm/kHz PIN 5		CHANNEL 9 dBm/kHz TS19-4, WIRE A
POSITION 9 dBm/kHz PIN 6		CHANNEL 9 dBm/kHz TS19-1
POSITION 9 dBm/kHz PIN 7		CHANNEL 9 dBm/kHz TSL/F T9
POSITION 10 dBm/kHz WIRE B		CHANNEL 10 dBm/kHz TS20-6
POSITION 10 dBm/kHz PIN 1		CHANNEL 10 dBm/kHz TSL/F S10
POSITION 10 dBm/kHz PIN 2		CHANNEL 10 dBm/kHz TS20 3
POSITION 10 dBm/kHz PIN 3		CHANNEL 10 dBm/kHz TS20-5
POSITION 10 dBm/kHz PIN 4		CHANNEL 10 dBm/kHz TSL/F R10
POSITION 10 dBm/kHz PIN 5		CHANNEL 10 dBm/kHz TS20-4, WIRE A
POSITION 10 dBm/kHz PIN 6		CHANNEL 10 dBm/kHz TS20-1
POSITION 10 dBm/kHz PIN 7		CHANNEL 10 dBm/kHz TSL/F-T10

[53]

NOISE (dBrn)		
JACK AND LAMP/RELAY POSITIONS	TO	EQUIPMENT SHELF INPUT CHANNELS
POSITION 1 dBrn WIRE B		CHANNEL 1 dBrn TS21-6
POSITION 1 dBrn PIN 1		CHANNEL 1 dBrn TSN-S1
POSITION 1 dBrn PIN 2		CHANNEL 1 dBrn TS21-3
POSITION 1 dBrn PIN 3		CHANNEL 1 dBrn TS21 5
POSITION 1 dBrn PIN 4		CHANNEL 1 dBrn TSN-R1
POSITION 1 dBrn PIN 5		CHANNEL 1 dBrn TS21-4, WIRE A
POSITION 1 dBrn PIN 6		CHANNEL 1 dBrn TS21-1
POSITION 1 dBrn PIN 7		CHANNEL 1 dBrn TSN T1
POSITION 2 dBrn WIRE B		CHANNEL 2 dBrn TS22-6
POSITION 2 dBrn PIN 1		CHANNEL 2 dBrn TSN S2
POSITION 2 dBrn PIN 2		CHANNEL 2 dBrn TS22 3
POSITION 2 dBrn PIN 3		CHANNEL 2 dBrn TS22 5
POSITION 2 dBrn PIN 4		CHANNEL 2 dBrn TSN-R2
POSITION 2 dBrn PIN 5		CHANNEL 2 dBrn TS22-4, WIRE A
POSITION 2 dBrn PIN 6		CHANNEL 2 dBrn TS22-1
POSITION 2 dBrn PIN 7		CHANNEL 2 dBrn TSN-T2
POSITION 3 dBrn WIRE B		CHANNEL 3 dBrn TS23 6
POSITION 3 dBrn PIN 1		CHANNEL 3 dBrn TSN S3
POSITION 3 dBrn PIN 2		CHANNEL 3 dBrn TS23 3
POSITION 3 dBrn PIN 3		CHANNEL 3 dBrn TS23 5
POSITION 3 dBrn PIN 4		CHANNEL 3 dBrn TSN-R3
POSITION 3 dBrn PIN 5		CHANNEL 3 dBrn TS23-4, WIRE A
POSITION 3 dBrn PIN 6		CHANNEL 3 dBrn TS23 1
POSITION 3 dBrn PIN 7		CHANNEL 3 dBrn TSN T3
POSITION 4 dBrn WIRE B		CHANNEL 4 dBrn TS24-6
POSITION 4 dBrn PIN 1		CHANNEL 4 dBrn TSN-S4
POSITION 4 dBrn PIN 2		CHANNEL 4 dBrn TS24 3
POSITION 4 dBrn PIN 3		CHANNEL 4 dBrn TS24 5
POSITION 4 dBrn PIN 4		CHANNEL 4 dBrn TSN R4
POSITION 4 dBrn PIN 5		CHANNEL 4 dBrn TS24-4, WIRE A
POSITION 4 dBrn PIN 6		CHANNEL 4 dBrn TS24 1
POSITION 4 dBrn PIN 7		CHANNEL 4 dBrn TSN T4
POSITION 5 dBrn WIRE B		CHANNEL 5 dBrn TS25 6
POSITION 5 dBrn PIN 1		CHANNEL 5 dBrn TSN S5
POSITION 5 dBrn PIN 2		CHANNEL 5 dBrn TS25 3
POSITION 5 dBrn PIN 3		CHANNEL 5 dBrn TS25 5
POSITION 5 dBrn PIN 4		CHANNEL 5 dBrn TSN-R5
POSITION 5 dBrn PIN 5		CHANNEL 5 dBrn TS25-4, WIRE A
POSITION 5 dBrn PIN 6		CHANNEL 5 dBrn TS25-1
POSITION 5 dBrn PIN 7		CHANNEL 5 dBrn TSN-T5
POSITION 6 dBrn WIRE B		CHANNEL 6 dBrn TS26-6
POSITION 6 dBrn PIN 1		CHANNEL 6 dBrn TSN-S6
POSITION 6 dBrn PIN 2		CHANNEL 6 dBrn TS26-3
POSITION 6 dBrn PIN 3		CHANNEL 6 dBrn TS26 5
POSITION 6 dBrn PIN 4		CHANNEL 6 dBrn TSN R6
POSITION 6 dBrn PIN 5		CHANNEL 6 dBrn TS26-4, WIRE A
POSITION 6 dBrn PIN 6		CHANNEL 6 dBrn TS26 1
POSITION 6 dBrn PIN 7		CHANNEL 6 dBrn TSN-T6
POSITION 7 dBrn WIRE B		CHANNEL 7 dBrn TS27-6
POSITION 7 dBrn PIN 1		CHANNEL 7 dBrn TSN-S7
POSITION 7 dBrn PIN 2		CHANNEL 7 dBrn TS27-3
POSITION 7 dBrn PIN 3		CHANNEL 7 dBrn TS27 5
POSITION 7 dBrn PIN 4		CHANNEL 7 dBrn TSN-R7
POSITION 7 dBrn PIN 5		CHANNEL 7 dBrn TS27-4, WIRE A
POSITION 7 dBrn PIN 6		CHANNEL 7 dBrn TS27 1
POSITION 7 dBrn PIN 7		CHANNEL 7 dBrn TSN-T7
POSITION 8 dBrn WIRE B		CHANNEL 8 dBrn TS28 6
POSITION 8 dBrn PIN 1		CHANNEL 8 dBrn TSN S8
POSITION 8 dBrn PIN 2		CHANNEL 8 dBrn TS28 3
POSITION 8 dBrn PIN 3		CHANNEL 8 dBrn TS28 5
POSITION 8 dBrn PIN 4		CHANNEL 8 dBrn TSN R8
POSITION 8 dBrn PIN 5		CHANNEL 8 dBrn TS28-4, WIRE A
POSITION 8 dBrn PIN 6		CHANNEL 8 dBrn TS28 1
POSITION 8 dBrn PIN 7		CHANNEL 8 dBrn TSN-T8
POSITION 9 dBrn WIRE B		CHANNEL 9 dBrn TS29-6
POSITION 9 dBrn PIN 1		CHANNEL 9 dBrn TSN-S9
POSITION 9 dBrn PIN 2		CHANNEL 9 dBrn TS29-3
POSITION 9 dBrn PIN 3		CHANNEL 9 dBrn TS29-5
POSITION 9 dBrn PIN 4		CHANNEL 9 dBrn TSN R9
POSITION 9 dBrn PIN 5		CHANNEL 9 dBrn TS29-4, WIRE A
POSITION 9 dBrn PIN 6		CHANNEL 9 dBrn TS29-1
POSITION 9 dBrn PIN 7		CHANNEL 9 dBrn TSN-T9
POSITION 10 dBrn WIRE B		CHANNEL 10 dBrn TS30-6
POSITION 10 dBrn PIN 1		CHANNEL 10 dBrn TSN-S10
POSITION 10 dBrn PIN 2		CHANNEL 10 dBrn TS30 3
POSITION 10 dBrn PIN 3		CHANNEL 10 dBrn TS30-5
POSITION 10 dBrn PIN 4		CHANNEL 10 dBrn TSN-R10
POSITION 10 dBrn PIN 5		CHANNEL 10 dBrn TS30-4, WIRE A
POSITION 10 dBrn PIN 6		CHANNEL 10 dBrn TS30 1
POSITION 10 dBrn PIN 7		CHANNEL 10 dBrn TSN T10

[53]

ENGINEERING NOTES

[51]

[52] TABLE 1 SHOWS EACH EQUIPMENT SHELF INPUT CHANNEL CONNECTED TO A SINGLE ACCESS POSITION JACK. FOR TYPICAL SINGLE INPUT SCHEMATIC, REFERENCE S1140-B01 SHEET 2. FOR TYPICAL MULTIPLED INPUT SCHEMATIC, REFERENCE S1140-B01 SHEET 3

[53] CHANNEL 10 (dBm/kHz) AND (dBRN) ARE SHOWN CONNECTED FOR STANDARD JACK ACCESS. IF THE CALIBRATION STANDARD OPTION IS USED, CHANNEL 10 (dBm/kHz) AND (dBRN) MUST BE CONNECTED TO CALIBRATE KEY AS SHOWN ON S1140-B01 SHEET 2, FIGURE 4 OR ON S1140-B01 SHEET 3, FIGURE 8

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM		
DRAWING TITLE: INPUT WIRING TABLE		DRAWN BY: B G
		CHECKED BY: D G L
DRAWING NUMBER: S1140-B01	ISSUE: -05	SHEET: 1 OF 3
		RELEASED BY: D.R.S

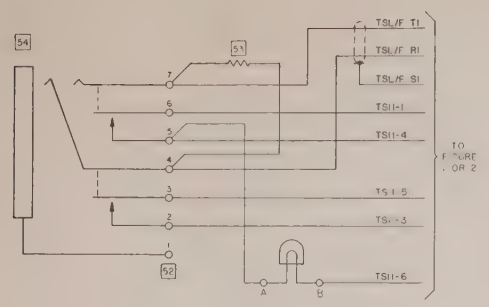


FIGURE 3-TYPICAL INPUT CHANNEL

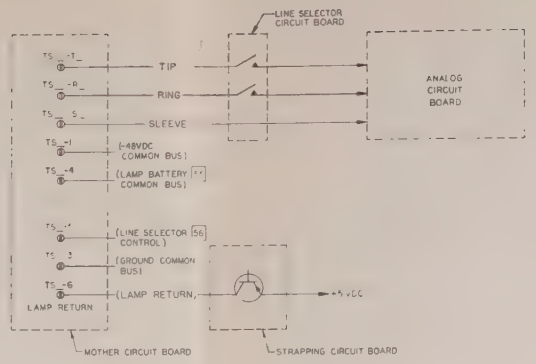


FIGURE 1-TYPICAL INPUT CHANNEL (USING SCANNING LOCKOUT SWITCH) 58

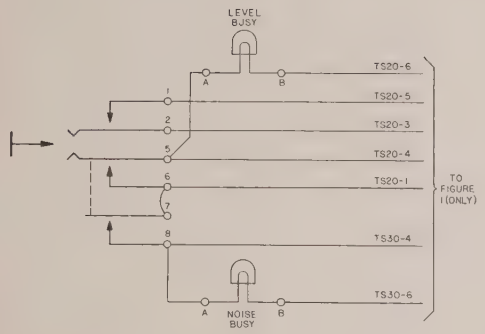


FIGURE 4-TYPICAL CALBRATE INPUT

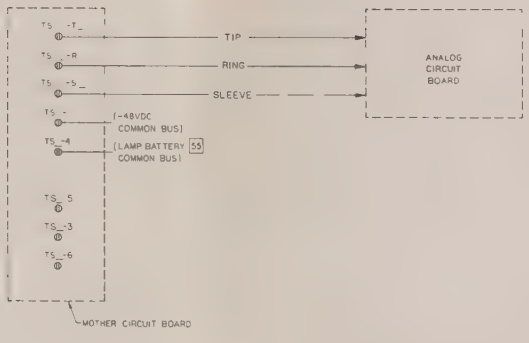


FIGURE 2-TYPICAL INPUT CHANNEL (NOT USING SCANNING LOCKOUT SWITCH) 57 56

ENGINEERING NOTES

51

52 SHIELD OF SIGNAL CABLE NOT TO BE CONNECTED TO JACK TERMINAL SLEEVE (JACK TERMINAL 11)

53 TERMINATING RESISTOR SHOULD BE LOCATED AT THE MOST REMOTE JACK IN THE LINEUP. CUSTOMER PROVIDED RESISTOR MAY BE 135 OHMS, 800 OHMS OR 900 OHMS (0.1%, 5-WATT FOR 600 AND 900 OHMS; 0.1%, 10-WATT FOR 135 OHMS). STRAPPING ON THE STRAPPING BOARD IN THE 1140 EQUIPMENT SHELF MUST COINCIDE WITH VALUE USED. SEE INSTALLATION INSTRUCTIONS.

54 FIGURE 3 SHOWS A TYPICAL TERMINATING JACK AND INTERCONNECT BETWEEN THE JACK AND THE 1140 EQUIPMENT SHELF LEVEL/FREQUENCY CHANNEL 1. ALL TEN LEVEL/FREQUENCY AND ALL TEN NOISE INPUT CHANNELS ARE WIRED IN AN IDENTICAL MANNER. THE DIFFERENCE BEING TERMINAL DESIGNATIONS ONLY.

55 JACK TERMINALS 6 TO 5 AND TS11-4 PROVIDE -48VDC TO BUSY LAMP/RELAY AT POSITIONS 2 THRU 10 WHEN LEVEL/FREQUENCY INPUT CHANNEL 1 IS ACCESSED (PLUG INSERTED) LEVEL/FREQUENCY POSITION 1 BUSY LAMP/RELAY IS EXTINGUISHED (EXCEPT IN NOTE 57). THE BUSY LAMPS/RELAYS AT THE REMAINING NINE LEVEL/FREQUENCY POSITIONS ARE ENERGIZED. LEVEL/FREQUENCY INPUT CHANNELS 2 THRU 10 AND NOISE INPUT CHANNELS 1 THRU 10 FUNCTION IN THE SAME MANNER WHEN ACCESSED.

56 JACK TERMINALS 2 TO 3 AND TS11-5 PROVIDE A GROUND COMMAND TO THE LINE SELECTOR CIRCUIT BOARD THAT CAUSES ONE INPUT CHANNEL TO BE SELECTED AT A TIME. LEVEL/FREQUENCY INPUT CHANNELS 2 THRU 10 AND NOISE INPUT CHANNELS 1 THRU 10 FUNCTION IN THE SAME MANNER. THE DIFFERENCE BEING TERMINAL DESIGNATIONS ONLY.

57 FIGURE 2 SHOWS A TYPICAL INPUT CHANNEL WITHOUT SCANNING LOCKOUT SWITCHES INSTALLED IN THE 1140 EQUIPMENT SHELF. THE SUBSTITUTION CIRCUIT BOARDS PART NUMBERS ARE:

A STRAPPING CIRCUIT BOARD SUBSTITUTE P1140-014

B LINE SELECTOR CIRCUIT BOARD SUBSTITUTE P1140-013

THE USE OF THE SUBSTITUTE CIRCUIT BOARDS IN PLACE OF THE SCANNING LOCKOUT SWITCHES DOES NOT ALLOW THE 1140 EQUIPMENT SHELF TO AUTOMATICALLY SELECT AN INPUT CHANNEL (NOTE 56) NOR DOES IT PROVIDE BUSY LAMP/RELAY CONTROL AT THE POSITION ACCESSED (NOTE 55). WHEN LEVEL/FREQUENCY POSITION 1 IS ACCESSED ALL BUSY LAMPS/RELAYS AT ALL LEVEL/FREQUENCY POSITIONS WILL BE TURNED ON. IN ADDITION NO OTHER LEVEL/FREQUENCY POSITION MUST BE ACCESSED. LEVEL/FREQUENCY INPUT CHANNELS 2 THRU 10 AND NOISE INPUT CHANNELS 1 THRU 10 FUNCTION IN THE SAME MANNER WHEN ACCESSED. THE DIFFERENCE BEING TERMINAL DESIGNATIONS ONLY.

58 FIGURES 1 AND 2 MAY BE INTERFACED THROUGH OTHER CUSTOMER INPUT CONFIGURATIONS. FIGURES 3, 4, 6, 7 AND 8 ARE TYPICAL EXAMPLES ONLY.

TTi 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

DRAWING TITLE:			DRAWN BY
INTERCONNECT SCHEMATIC, SINGLE INPUTS			BG
			CHECKED BY
			DGL
DRAWING NUMBER:	ISSUE	SHEET	RELEASED BY
S1140-B01	06	2 OF 3	DRS

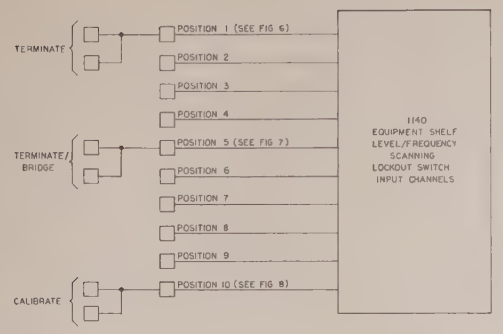


FIGURE 5 - BLOCK DIAGRAM, MULTIPLE INPUTS TO 52 LEVEL/FREQUENCY SCANNING LOCKOUT SWITCH.

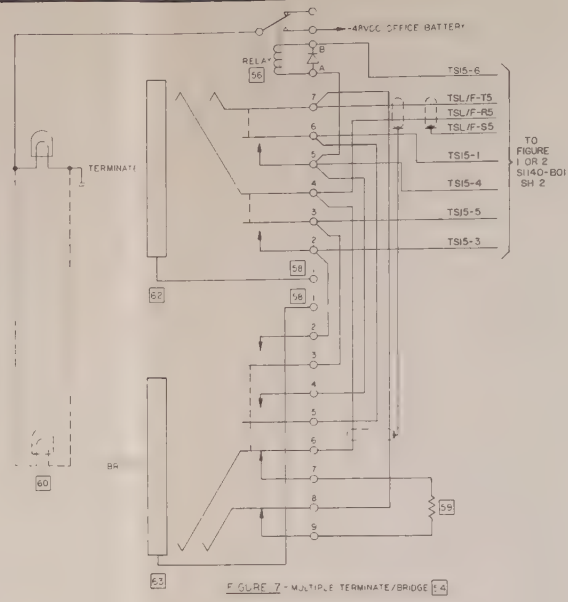


FIGURE 7 - MULTIPLE TERMINATE/BRIDGE 54

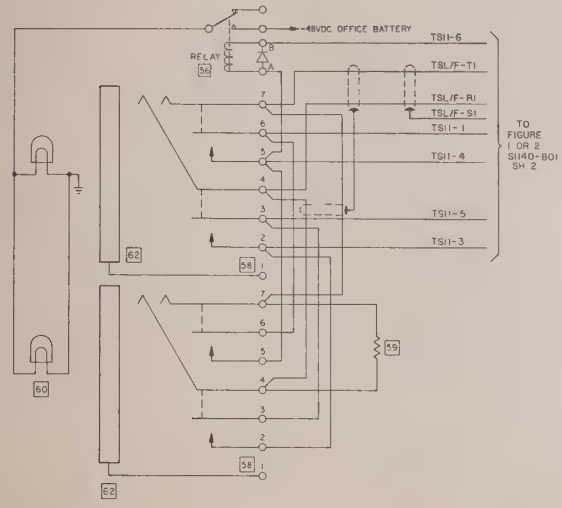


FIGURE 6 - MULTIPLE TERMINATE 53

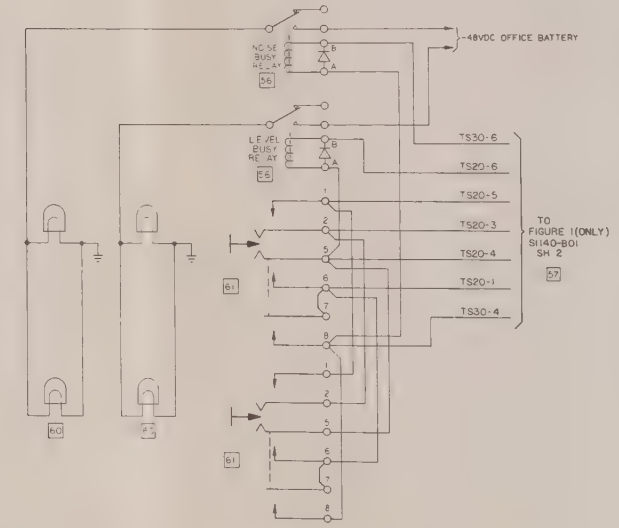


FIGURE 8 - MULTIPLE CALIBRATE 55

ENGINEERING NOTES

51

52 FIGURE 5 SHOWS ARRANGEMENT OF MULTIPLE INPUTS TO 1140 EQUIPMENT SHELF AND LEVEL/FREQUENCY SCANNING LOCK OUT SWITCH. NOISE INPUTS COULD BE ARRANGED IN THE SAME MANNER

53 FIGURE 6 SHOWS A MULTIPLE INPUT ARRANGEMENT (TERMINATING JACKS) AT LEVEL/FREQUENCY ACCESS POSITION NO 5 RELAY CONTROL OF THE MULTIPLE BUSY LAMPS IS SHOWN

54 FIGURE 7 SHOWS A MULTIPLE INPUT ARRANGEMENT (TERMINATING/BRIDGING) AT LEVEL/FREQUENCY ACCESS POSITION NO 5 RELAY CONTROL OF THE MULTIPLE BUSY LAMPS IS SHOWN

55 FIGURE 8 SHOWS A MULTIPLE INPUT ARRANGEMENT (CALIBRATE) AT LEVEL/FREQUENCY ACCESS POSITION NO 10 RELAY CONTROL OF THE MULTIPLE BUSY LAMPS IS SHOWN

56 CUSTOMER PROVIDED RELAY REQUIRED TO DRIVE MULTIPLE BUSY LAMPS BECAUSE OF CURRENT LIMITATIONS MULTIPLE BUSY LAMP CIRCUITS SHOULD NOT BE POWERED DIRECTLY FROM LINES "A" & "B". USE WECO AK4 OR A E TYPE 58A

57 TS20-6 & TS20-4 (LEVEL/FREQUENCY) PROVIDE LEVEL BUSY INDICATION WHEN ANY LEVEL POSITION IS ACCESSED TS30-6 & TS30-4 PROVIDE NOISE BUSY INDICATION WHEN ANY NOISE POSITION IS ACCESSED IF BOTH NOISE & LEVEL POSITIONS HAVE BEEN ACCESSED LEVEL BUSY & NOISE BUSY INDICATORS WILL BE ILLUMINATED

58 DO NOT CONNECT SHIELD OF SIGNAL CABLE TO JACK SLEEVE TERMINAL (TERMINAL 1) THE SHIELD MUST BE GROUNDED AT 1140 EQUIPMENT SHELF S TERMINAL ONLY

59 TERMINATING RESISTOR SHOULD BE LOCATED AT THE MOST REMOTE JACK IN THE LINEUP CUSTOMER PROVIDED RESISTOR MAY BE 135 OHMS, 600 OHMS OR 900 OHMS (0.1% 5 WATT FOR 600 AND 900 OHMS 0.1% 10 WATT FOR 135 OHMS) STRAPPING ON THE STRAPPING BOARD IN THE 1140 EQUIPMENT SHELF MUST COINCIDE WITH VALUE USED SEE INSTALLATION INSTRUCTIONS

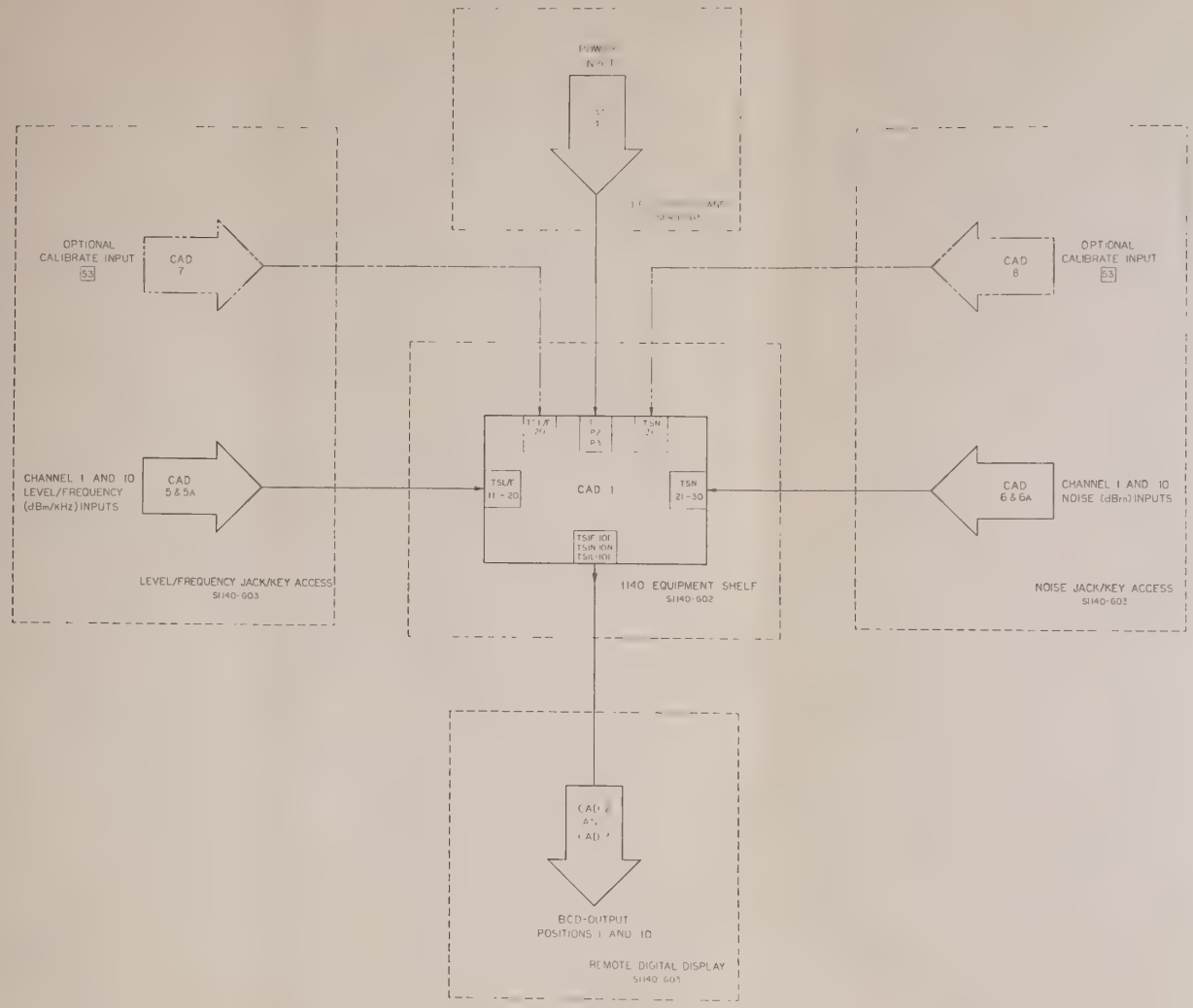
60 LAMP SOCKET 47B (WECO), 247 (TRIMM) OR EQUIVALENT (CUSTOMER PROVIDED)

61 KEY 547E (WECO) OR EQUIVALENT (CUSTOMER PROVIDED) PINS 3 AND 4 NOT SHOWN

62 JACK 285A, 324C (WECO) OR EQUIVALENT (CUSTOMER PROVIDED)

63 JACK, BRIDGING 290B (WECO) OR EQUIVALENT (CUSTOMER PROVIDED)

TRI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM	
DRAWING TITLE: INTERCONNECT SCHEMATIC, MULTIPLED INPUTS	DRAWN BY: B G
	CHECKED BY: D.G.L
DRAWING NUMBER: S1140-B01 / ISSUE: -03 / SHEET: 3 OF 3	RELEASED BY: D.R.S



ENGINEERING NOTES

51

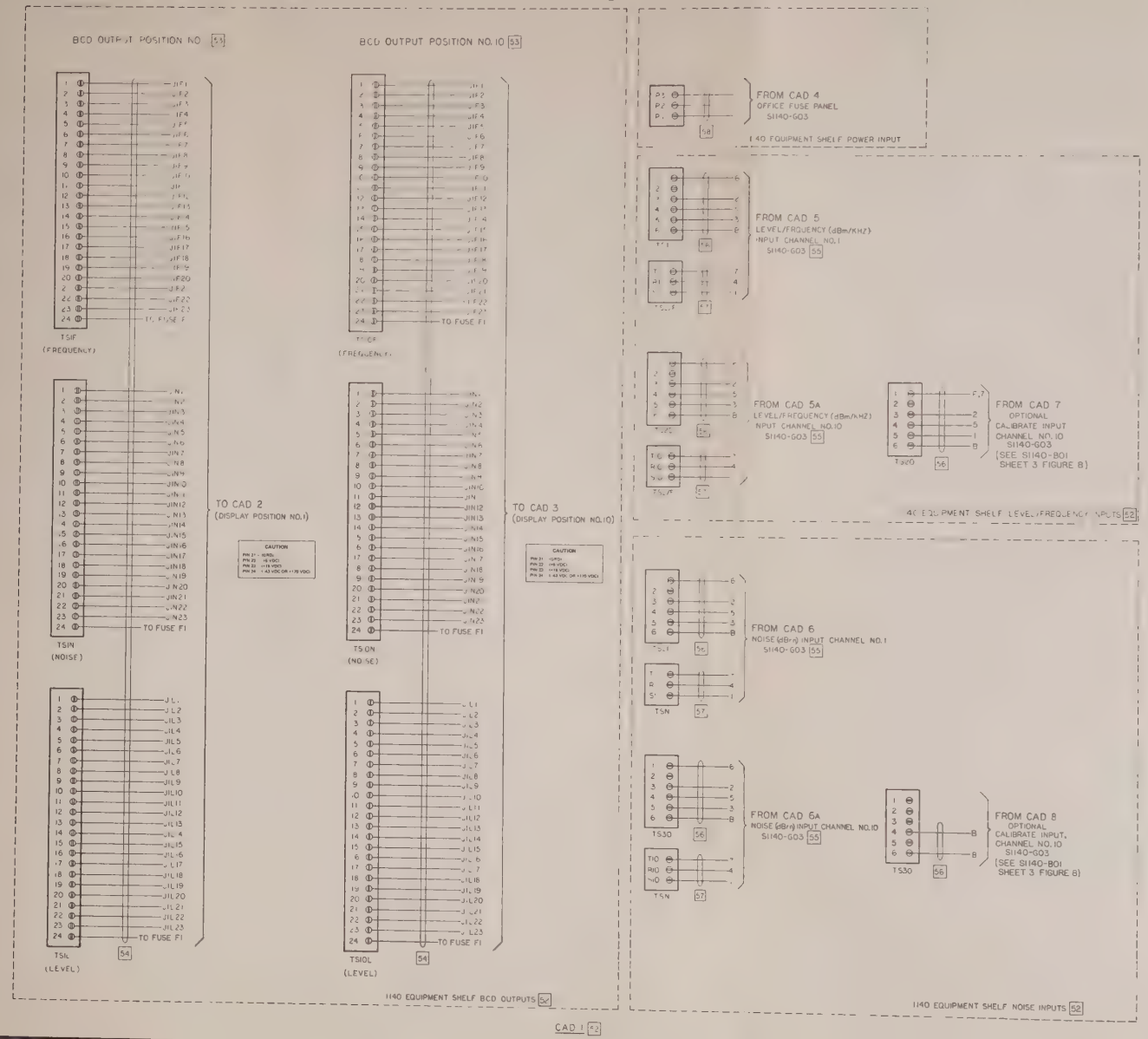
52 CAD = CABLE ASSEMBLY DRAWING

53 LEVEL/FREQUENCY INPUT CHANNEL 10 CAN BE WIRED AS A STANDARD INPUT, HOWEVER MUST BE WIRED AS THE CALIBRATOR INPUT WHEN THE CALIBRATION STANDARD OPTION (PART NO TTI 1140A-2 LIST 4) IS USED. REFERENCE NOTE 61 ON DRAWING T1140-801, SHEET 1. BOTH CAD 7 AND CAD 8 MUST BE INSTALLED

54 NOISE INPUT CHANNEL 10 CAN BE WIRED AS A STANDARD INPUT, HOWEVER MUST BE WIRED AS THE NOISE CALIBRATOR INPUT WHEN THE CALIBRATION STANDARD OPTION (PART NO. TTI 1140A-2 LIST 4) IS USED REFERENCE NOTE 61 ON DRAWING T1140-801, SHEET 1. BOTH CAD 7 AND CAD 8 MUST BE INSTALLED.

TTi 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

DRAWING TITLE			DRAWN BY
CABLE ASSEMBLY, DRAWING APPLICATIONS			B G
			CHECKED BY: D.G.L
DRAWING NUMBER: S1140-G01	ISSUE: -03	SHEET: 1 OF 1	RELEASED BY: D.R.S.


BCD OUTPUT POSITION NO. 1 53
BCD OUTPUT POSITION NO. 10 53
TSIF (FREQUENCY)
TSIOF (FREQUENCY)
TO FUSE F1
TSIN (NOISE)
TSION (NOISE)
TSIL (LEVEL)
TSIOL (LEVEL)
54
TO CAD 2 (DISPLAY POSITION NO.1)
TO CAD 3 (DISPLAY POSITION NO.10)
CAUTION
1140 EQUIPMENT SHELF BCD OUTPUTS 52
FROM CAD 4 OFFICE FUSE PANEL S1140-G03
58
1140 EQUIPMENT SHELF POWER INPUT
FROM CAD 5 LEVEL/FREQUENCY (dBm/KHZ) INPUT CHANNEL NO.1 S1140-G03 55
FROM CAD 5A LEVEL/FREQUENCY (dBm/KHZ) INPUT CHANNEL NO.10 S1140-G03 55
TS1F
TS10F
TS20
56
FROM CAD 7 OPTIONAL CALIBRATE INPUT CHANNEL NO. 10 S1140-G03 (SEE S1140-B01 SHEET 3 FIGURE 8)
1140 EQUIPMENT SHELF LEVEL/FREQUENCY INPUTS 52
FROM CAD 6 NOISE (dBrn) INPUT CHANNEL NO.1 S1140-G03 55
FROM CAD 6A NOISE (dBrn) INPUT CHANNEL NO.10 S1140-G03 55
TS1N
TS10N
TS30
57
FROM CAD 8 OPTIONAL CALIBRATE INPUT, CHANNEL NO.10 S1140-G03 (SEE S1140-B01 SHEET 3 FIGURE 8)
1140 EQUIPMENT SHELF NOISE INPUTS 52
CAD 1 52

ENGINEERING NOTES

51

52 ALL CONNECTIONS USE WIRE WRAP TERMINALS (.062"X.031") TERMINAL SPACING .150" MINIMUM. USE BELL SYSTEMS WIRE WRAP TOOL, KS-16363 LIST 1 OR EQUIVALENT. REFERENCE GENERAL SYSTEM PRACTICES SECTION 075-630-101 ISSUE 2, MARCH 1969 OR EQUIVALENT

53 BCD OUTPUT POSITIONS 2 THRU 9 ARE IDENTICAL IN ELECTRICAL CONNECTION TO POSITIONS 1 AND 10 SHOWN

54 BCD INTER-CONNECT CABLE
289A OR 257A (WECO), GT-17 PAIR (AUTOMATIC ELECTRIC), 24(1)1B80 (MOHAWK), OR EQUIVALENT. (BASIC CABLE REQUIREMENTS, 24 GAUGE, UNSHIELDED, 72 CONDUCTORS PLUS SPARES, MAXIMUM CABLE LENGTH 1000 FEET (SEE TABLE C, J1140-002 SHEET 2)

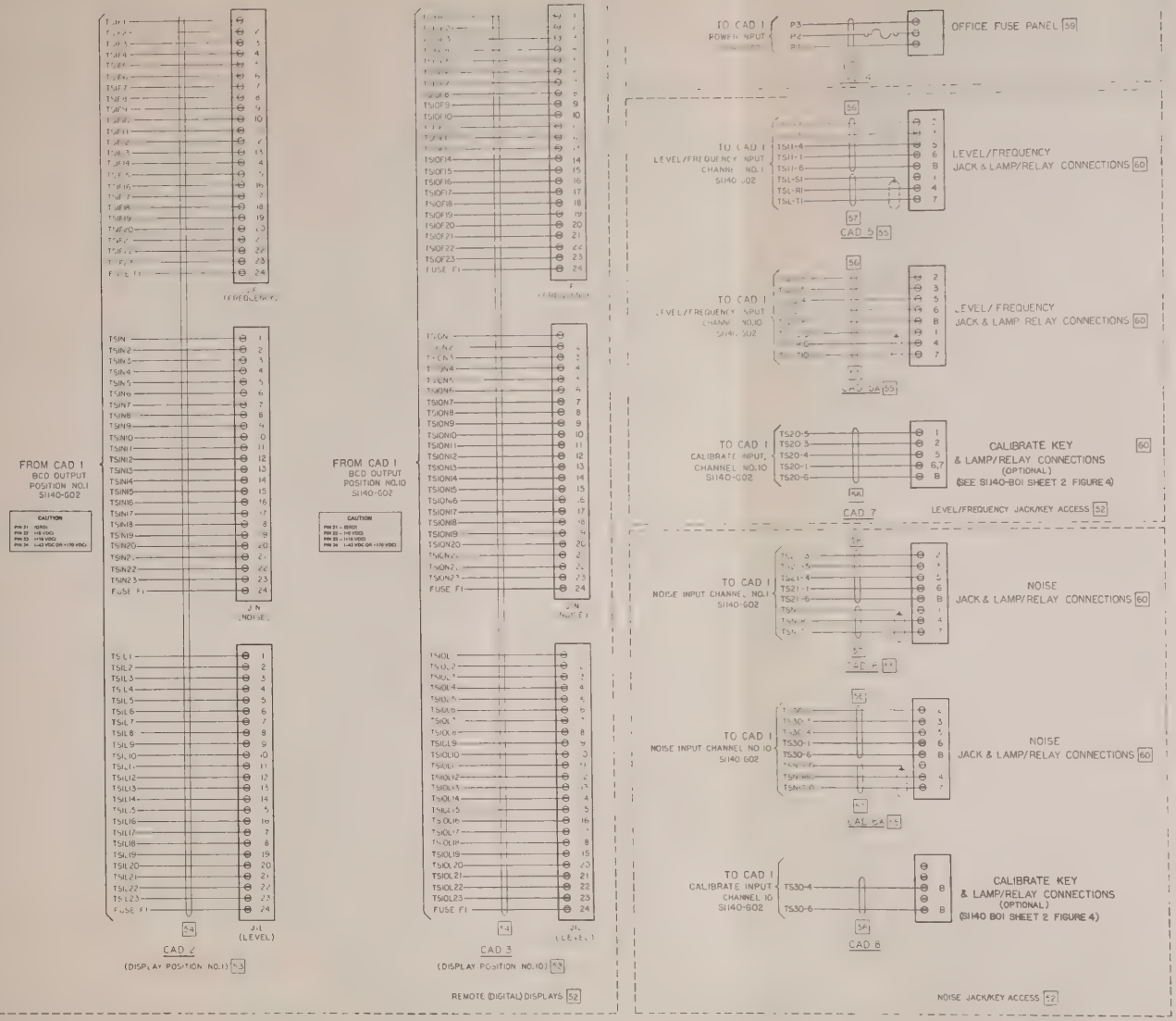
55 INPUT CHANNELS 2 THRU 9 ARE IDENTICAL IN ELECTRIC CONNECTION TO CHANNELS 1 AND 10 SHOWN

56 CONTROL CABLE
GT-17 6 PAIR (AUTOMATIC ELECTRIC), 252A OR 252CL (WECO) 24(1) 8B (MOHAWK) OR EQUIVALENT (BASIC CABLE REQUIREMENT: 24 GAUGE, UNSHIELDED, 5 CONDUCTORS PLUS SPARES, MAXIMUM CABLE LENGTH 1000 FEET (SEE TABLE D, J1140-002 SHEET 2)

57 SIGNAL CABLE
112-00152-05 (LENKURT), 248F (WECO), T43M (GENERAL CABLE) OR EQUIVALENT (BASIC CABLE REQUIREMENTS: 24 GAUGE, SHIELDED PAIR, LESS THAN 20 PICOFARADS PER FOOT, MAXIMUM CABLE LENGTH 250 FEET.) UNSHIELDED PORTION OF TIP (T) AND RING (R) LEADS NOT TO EXCEED 3.0" SLEEVE(S) NOT TO BE GROUNDED AT JACK PANEL. GROUND AT EQUIPMENT SHELF INPUT CHANNEL(S) TERMINAL ONLY (SEE TABLE D, J1140-002 SHEET 2)

58 POWER CABLE
16 AM (WECO) OR EQUIVALENT (BASIC CABLE REQUIREMENTS: 16 GAUGE, SOLID TINNED COPPER, MAXIMUM CABLE LENGTH 250 FEET, 2 OR 3 CONDUCTORS (SEE TABLE A, J1140-002 SHEET 2)

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM			
DRAWING TITLE: CAD 1, EQUIPMENT SHELF			DRAWN BY: B G
			CHECKED BY: D.G.L
DRAWING NUMBER: S1140-G02	ISSUE: -06	SHEET: 1 OF 1	RELEASED BY: D R S



ENGINEERING NOTES

51

52 ALL CONNECTIONS USE WIRE WRAP TERMINALS (.062"X 031") TERMINAL SPACING .150" MINIMUM USE BELL SYSTEMS WIRE WRAP TOOL, KS-16363 LIST 1 OR EQUIVALENT. REFERENCE GENERAL SYSTEM PRACTICES SECTION 075-630-101 ISSUE 2 MARCH 1969 OR EQUIVALENT.

53 BCD-OUTPUT POSITIONS 2 THRU 9 ARE IDENTICAL IN ELECTRICAL CONNECTION TO POSITIONS 1 AND 10 SHOWN

54 **BCD INTER-CONNECT CABLE**
269A OR 257A (WECO), GT 17 50 PAIR (AUTOMATIC ELECTRIC), 24(1)B80 (MOHAWK), OR EQUIVALENT. (BASIC CABLE REQUIREMENTS: 24 GAUGE, UNSHIELDED, 72 CONDUCTORS PLUS SPARES, MAXIMUM CABLE LENGTH 2000 FEET (SEE TABLE C, J1140-002 SHEET 2.)

55 INPUT CHANNELS 2 THRU 9 ARE IDENTICAL IN ELECTRICAL CONNECTION TO CHANNELS 1 AND 10 SHOWN.

56 **CONTROL CABLE**
GT-17 6 PAIR (AUTOMATIC ELECTRIC), 252A OR 252CL (WECO), 24(1) 88 (MOHAWK) OR EQUIVALENT (BASIC CABLE REQUIREMENT, 24 GAUGE, UNSHIELDED, 5 CONDUCTORS PLUS SPARES, MAXIMUM CABLE LENGTH 2000 FEET. (SEE TABLE D, J1140-002 SHEET 2.)

57 **SIGNAL CABLE**
112-00152-05 (LENKURT), 24BF (WECO) T43M (GENERAL CABLE), OR EQUIVALENT (BASIC CABLE REQUIREMENTS, 24 GAUGE, SHIELDED PAIR, LESS THAN 20 PICOFARADS PER FOOT, MAXIMUM CABLE LENGTH 250 FEET) UNSHIELDED PORTION OF TIP (T) AND RING (R) LEADS NOT TO EXCEED 3.0". SLEEVE(S) NOT TO BE GROUNDED AT JACK PANEL, GROUND AT EQUIPMENT SHELF INPUT CHANNEL(S) TERMINAL ONLY (SEE TABLE D, J1140-002 SHEET 2.)

58 **POWER CABLE**
16 AM (WECO) OR EQUIVALENT (BASIC CABLE REQUIREMENTS, 16 GAUGE, SOLID TINNED COPPER, MAXIMUM CABLE LENGTH 250 FEET, 2 OR 3 CONDUCTORS DEPENDING ON POWER SUPPLY USED. (SEE TABLE A, J1140-002 SHEET 2.)

59 WHEN THE –48VDC POWER SUPPLY IS USED (PART NO. TTI 1140A-2 LIST 5) FUSE AT OFFICE FUSE BOARD SHOULD BE 70D, 35H (WECO) OR EQUIVALENT

60 REFERENCE S1140-801 DRAWINGS FOR JACK/KEY, AND LAMP, RELAY WIRING SCHEMATICS

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM			
DRAWING TITLE: CAD 2 THRU CAD 8, INPUTS AND DISPLAYS			DRAWN BY: B G
			CHECKED BY: D G L
DRAWING NUMBER: S1140-G03	ISSUE: -06	SHEET: 1 OF 1	RELEASED BY: D R S

SHEET INDEX

CONTENTS	SHEET NO.	REPRINT NO.									
		1	2	3	4	5	6	7	8	9	10
1. "T" DRAWING INDEX	A01	-04	-05	-06							
2. EQUIPMENT SHELF, CABLING DIAGRAM	B01, SH1	-05	-06	-06							
3. EQUIPMENT SHELF, CABLING DIAGRAM	B01, SH2	-05	-05	-05							
4. CABLING DIAGRAM, WIRING TABLES	B03	-02	-02	-02							
5. DISPLAYS, CABLING DIAGRAM (LIST 8,9,12)	B04, SH1	-03	-03	-04							
6. DISPLAYS, CABLING DIAGRAM (LIST 10, 13)	B04, SH2	-03	-03	-03							
7. CABLING DIAGRAM, INPUTS	B05	-05	-06	-06							

ISSUE INFORMATION

ISSUE	ECO NO.	DATE
A	101	11/11/70
C	104	4/24/71
04	183	1/22/73
05	265	7/2/73
06	292	10/31/73

SHEET INDEX NOTES

1. WHEN CHANGES ARE MADE IN THIS DRAWING, ONLY THOSE SHEETS AFFECTED WILL BE REISSUED.
2. THIS SHEET INDEX WILL BE REISSUED AND BROUGHT UP TO DATE EACH TIME ANY SHEET OF THE DRAWING IS REISSUED, OR A NEW SHEET IS ADDED.
3. THE ISSUE NUMBER ASSIGNED TO A CHANGED OR NEW SHEET WILL BE THE SAME ISSUE NUMBER AS THAT OF THE REPRINT ISSUE NUMBER ABOVE.
4. SHEETS THAT ARE NOT CHANGED WILL RETAIN THEIR EXISTING ISSUE NUMBER.
5. THE LAST ISSUE NUMBER OF THE SHEET INDEX IS RECOGNIZED AS THE LATEST ISSUE NUMBER OF THE DRAWING AS A WHOLE.

SUPPORTING INFORMATION

CATEGORY	NO.
1. EQUIPMENT OUTLINE DRAWINGS	J1140-001, SH 1 (INDEX)
2. INTERCONNECT SCHEMATICS, CABLE ASSEMBLY DRAWINGS	J1140-A01 (INDEX)

TTi 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

DRAWING TITLE:			DRAWN BY:
"T" DRAWING INDEX			B.G.
			CHECKED BY: D.G.L.
DRAWING NUMBER: T1140-A01	ISSUE: -06	SHEET: 1 OF 1	RELEASED BY: D.R.S.

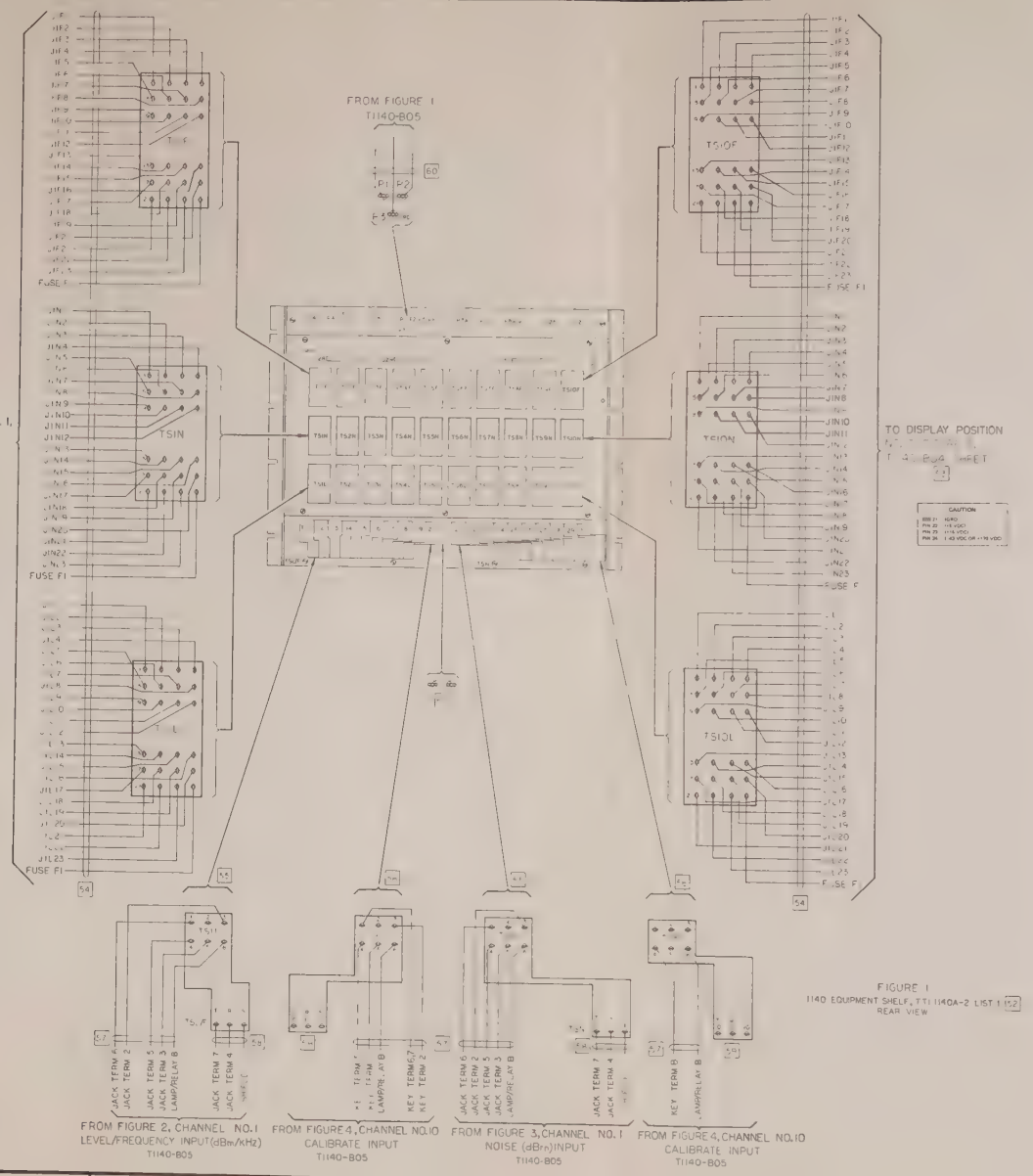


FIGURE 1
1140 EQUIPMENT SHELF, TTI 1140A-2 LIST 1 52
REAR VIEW

ENGINEERING NOTES

51

52 ALL CONNECTIONS USE WIRE WRAP TERMINALS, (.062"X.031") TERMINAL SPACING .150" MINIMUM. USE BELL SYSTEMS WIRE WRAP TOOL KS-16363, LIST 1 OR EQUIVALENT. REFERENCE GENERAL SYSTEMS PRACTICES SECTION 075-630-101, ISSUE 2, MARCH, 1969 OR EQUIVALENT

53 POSITIONS 2 THRU 9 ARE IDENTICAL IN ELECTRICAL CONNECTION TO POSITIONS 1 AND 10 SHOWN

54 BCD INTER-CONNECT CABLE
269A OR 257A (WECO); G T -17 50 PAIR (AUTOMATIC ELECTRIC); 24(1) 880 (MOHAWK) OR EQUIVALENT (BASIC CABLE REQUIREMENTS 24 GAUGE, UNSHIELDED, 72 CONDUCTORS + SPARES) MAXIMUM CABLE LENGTH 1000 FEET (SEE TABLE C, J1140-002 SHEET 2.)

55 CHANNELS 2 THRU 10 ARE IDENTICAL IN ELECTRICAL CONNECTION TO CHANNEL 1 SHOWN

56 LEVEL/FREQUENCY INPUT CHANNEL 10 (TS20) AND NOISE INPUT CHANNEL 10 (TS30) CAN BE WIRED FOR STANDARD INPUT (NOTE 55) OR AS THE CALIBRATE INPUT (SHOWN). NO OTHER CHANNELS CAN BE USED AS THE CALIBRATE INPUT (SEE S1140-B01 FIGURE 4)

57 CONTROL CABLE
G.T.-17 6 PAIR (AUTOMATIC ELECTRIC), 252A OR 252CL (WECO), 24(1) 88 (MOHAWK) OR EQUIVALENT (BASIC CABLE REQUIREMENTS 24 GAUGE, UNSHIELDED 5 CONDUCTORS + SPARES). MAXIMUM CABLE LENGTH 250 FEET (SEE TABLE D, J1140-002 SHEET 2)

58 SIGNAL CABLE
[illegible] OR EQUIVALENT [illegible] SHIELDED PAIR [illegible] FEET) UNSHIELDED PORTION OF TIP (T) AND RING (R) LEADS NOT TO EXCEED 3.0". SLEEVE(S) NOT TO BE CONNECTED AT JACK PANEL, GROUND AT EQUIPMENT SHELF INPUT CHANNEL(S) TERMINAL ONLY (SEE TABLE D, J1140-002 SHEET 2.)

59 SIGNAL CABLE (NOTE 58) IS NOT REQUIRED WHEN CHANNEL IS WIRED AS CALIBRATE INPUT. CALIBRATOR OUTPUT SIGNALS ARE HARD WIRED TO T10, R10, AND S10 INPUT TERMINALS VIA CIRCUIT BOARD TRACES

60 POWER CABLE
16 AM (WECO) OR EQUIVALENT (BASIC CABLE REQUIREMENTS 16 GAUGE, SOLID TINNED COPPER 2 OR 3 CONDUCTORS MAXIMUM CABLE LENGTH 250 FEET (SEE TABLE A, J1140-002 SHEET 2.)

61 WHEN THE 1140 IS EQUIPPED WITH THE CALIBRATION STANDARD (PART NO. TTI 1140A-2 LIST 4), THESE TERMINALS MUST BE SHORTED TOGETHER. DO NOT SHORT TOGETHER WHEN CALIBRATION STANDARD IS NOT USED IN THE 1140 EQUIPMENT SHELF.

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM	
DRAWING TITLE: CABLING DIAGRAM, EQUIPMENT SHELF	DRAWN BY: B.G
	CHECKED BY: D.G.L
DRAWING NUMBER: T1140-B01 / ISSUE: -06 / SHEET: 1 OF 2	RELEASED BY: D.R.S

ENGINEERING NOTES

51

52 WIRING FOR POSITIONS 2 THRU 10 ARE IDENTICAL TO POSITION 1 SHOWN

53 BCD CABLE INSULATION MUST BE STRIPPED BACK, TO ALLOW WIRE BUNDLES TO ENTER THE SIDE OF THE EQUIPMENT SHELF AND FANNING STRIPS

54 TO PERMIT REAR COVER REPLACEMENT, NO MORE THAN FIVE BCD OUTPUT CABLES SHOULD BE ROUTED INTO EACH SIDE OF THE EQUIPMENT SHELF. ONE BCD OUTPUT CABLE REQUIRES THREE FANNING STRIP SLOTS. WIRE BUNDLES SHOULD BE TIED

55 SIGNAL AND CONTROL CABLES CAN ENTER FROM ONE OR BOTH SIDES OF THE EQUIPMENT SHELF

56 UNSHIELDED PORTION OF TIP (T) AND RING (R) LEADS NOT TO EXCEED 3.0". CONTROL CABLE DRESS IS NOT CRITICAL. HOWEVER USE STANDARD GOOD WORKMANSHIP PRACTICES

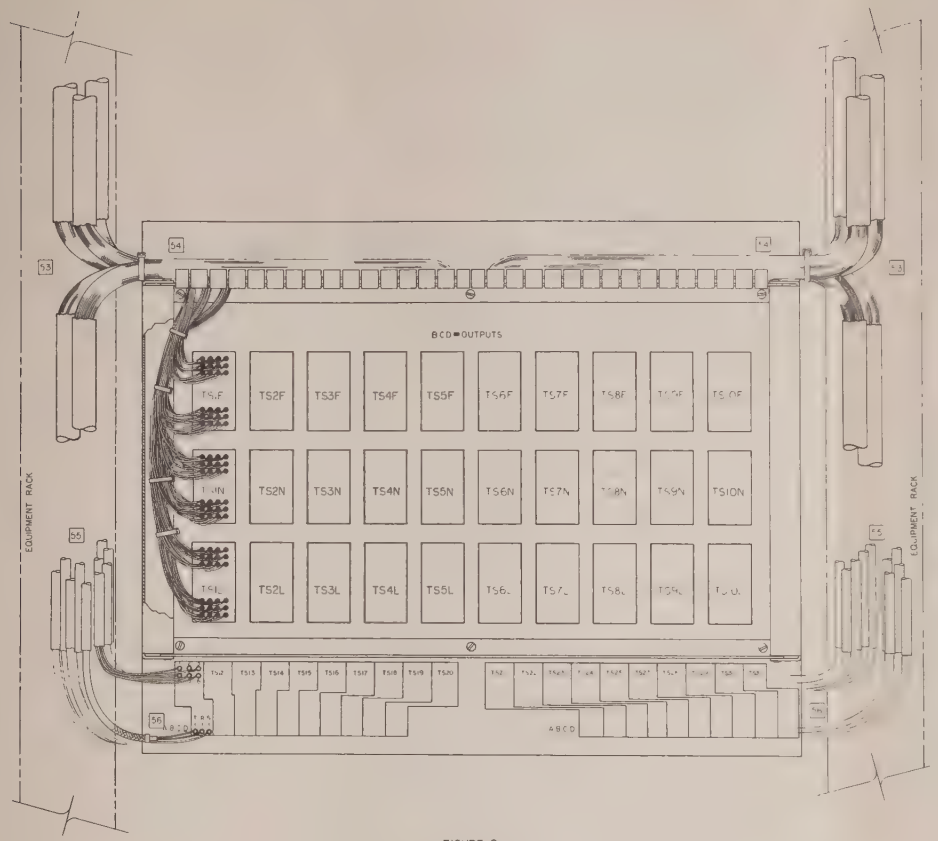


FIGURE 2
EQUIPMENT SHELF TTI 1140A-2 LIST 1
(REAR VIEW) 52

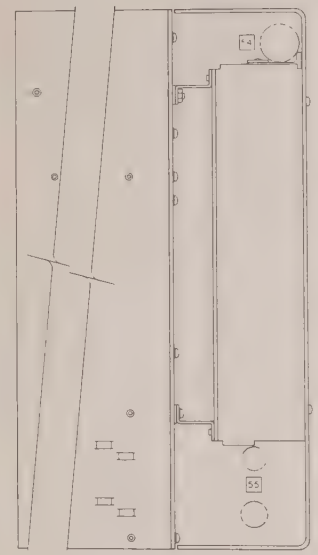


FIGURE 3
EQUIPMENT SHELF TTI 1140A-2 LIST 1
(SIDE VIEW)

TTi 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM			
DRAWING TITLE: CABLING DIAGRAM, EQUIPMENT SHELF			DRAWN BY: B G
			CHECKED BY: D.G L
DRAWING NUMBER: T1140-B01	ISSUE: -05	SHEET: 2 OF 2	RELEASED BY: D.R.S.

TABLE 1 [52]

dBm/kHz SIGNAL INPUT WIRING EQUIPMENT SHELF TO JACK, LAMP/RELAY AND KEY PANEL			POSITION	dBRN SIGNAL INPUT WIRING EQUIPMENT SHELF TO JACK, LAMP/RELAY AND KEY PANEL			POSITION
TS11-1	TO	JACK TERMINAL 6	1	TS21-1	TO	JACK TERMINAL 6	1
TS11-3	TO	JACK TERMINAL 2		TS21-3	TO	JACK TERMINAL 2	
TS11-4	TO	JACK TERMINAL 5		TS21-4	TO	JACK TERMINAL 5	
TS11-5	TO	JACK TERMINAL 3		TS21-5	TO	JACK TERMINAL 3	
TS11-6	TO	LAMP/RELAY TERMINAL B		TS21-6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T1	TO	JACK TERMINAL 7 (T)		TSN-T1	TO	JACK TERMINAL 7 (T)	
TSL/F-R1	TO	JACK TERMINAL 4 (R)		TSN-R1	TO	JACK TERMINAL 4 (R)	
TSL/F-S1	TO	JACK TERMINAL 1 (S)		TSN-S1	TO	JACK TERMINAL 1 (S)	
TS12-1	TO	JACK TERMINAL 6	2	TS22-1	TO	JACK TERMINAL 6	2
TS12-3	TO	JACK TERMINAL 2		TS22-3	TO	JACK TERMINAL 2	
TS12-4	TO	JACK TERMINAL 5		TS22-4	TO	JACK TERMINAL 5	
TS12-5	TO	JACK TERMINAL 3		TS22-5	TO	JACK TERMINAL 3	
TS12-6	TO	LAMP/RELAY TERMINAL B		TS22-6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T2	TO	JACK TERMINAL 7 (T)		TSN-T2	TO	JACK TERMINAL 7 (T)	
TSL/F-R2	TO	JACK TERMINAL 4 (R)		TSN-R2	TO	JACK TERMINAL 4 (R)	
TSL/F-S2	TO	JACK TERMINAL 1 (S)		TSN-S2	TO	JACK TERMINAL 1 (S)	
TS13-1	TO	JACK TERMINAL 6	3	TS23-1	TO	JACK TERMINAL 6	3
TS13-3	TO	JACK TERMINAL 2		TS23-3	TO	JACK TERMINAL 2	
TS13-4	TO	JACK TERMINAL 5		TS23-4	TO	JACK TERMINAL 5	
TS13-5	TO	JACK TERMINAL 3		TS23-5	TO	JACK TERMINAL 3	
TS13-6	TO	LAMP/RELAY TERMINAL B		TS23-6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T3	TO	JACK TERMINAL 7 (T)		TSN-T3	TO	JACK TERMINAL 7 (T)	
TSL/F-R3	TO	JACK TERMINAL 4 (R)		TSN-R3	TO	JACK TERMINAL 4 (R)	
TSL/F-S3	TO	JACK TERMINAL 1 (S)		TSN-S3	TO	JACK TERMINAL 1 (S)	
TS14-1	TO	JACK TERMINAL 6	4	TS24-1	TO	JACK TERMINAL 6	4
TS14 3	TO	JACK TERMINAL 2		TS24-3	TO	JACK TERMINAL 2	
TS14 4	TO	JACK TERMINAL 5		TS24-4	TO	JACK TERMINAL 5	
TS14 5	TO	JACK TERMINAL 3		TS24-5	TO	JACK TERMINAL 3	
TS14 6	TO	LAMP/RELAY TERMINAL B		TS24-6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T4	TO	JACK TERMINAL 7 (T)		TSN-T4	TO	JACK TERMINAL 7 (T)	
TSL/F-R4	TO	JACK TERMINAL 4 (R)		TSN-R4	TO	JACK TERMINAL 4 (R)	
TSL/F-S4	TO	JACK TERMINAL 1 (S)		TSN-S4	TO	JACK TERMINAL 1 (S)	
TS15-1	TO	JACK TERMINAL 6	5	TS25 1	TO	JACK TERMINAL 6	5
TS15-3	TO	JACK TERMINAL 2		TS25-3	TO	JACK TERMINAL 2	
TS15-4	TO	JACK TERMINAL 5		TS25-4	TO	JACK TERMINAL 5	
TS15 5	TO	JACK TERMINAL 3		TS25 5	TO	JACK TERMINAL 3	
TS15-6	TO	LAMP/RELAY TERMINAL B		TS25-6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T5	TO	JACK TERMINAL 7 (T)		TSN T5	TO	JACK TERMINAL 7 (T)	
TSL/F-R5	TO	JACK TERMINAL 4 (R)		TSN R5	TO	JACK TERMINAL 4 (R)	
TSL/F-S5	TO	JACK TERMINAL 1 (S)		TSN S5	TO	JACK TERMINAL 1 (S)	
TS16-1	TO	JACK TERMINAL 6	6	TS26-1	TO	JACK TERMINAL 6	6
TS16-3	TO	JACK TERMINAL 2		TS26-3	TO	JACK TERMINAL 2	
TS16-4	TO	JACK TERMINAL 5		TS26-4	TO	JACK TERMINAL 5	
TS16 5	TO	JACK TERMINAL 3		TS26 5	TO	JACK TERMINAL 3	
TS16 6	TO	LAMP/RELAY TERMINAL B		TS26 6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T6	TO	JACK TERMINAL 7 (T)		TSN T6	TO	JACK TERMINAL 7 (T)	
TSL/F-R6	TO	JACK TERMINAL 4 (R)		TSN R6	TO	JACK TERMINAL 4 (R)	
TSL/F-S6	TO	JACK TERMINAL 1 (S)		TSN S6	TO	JACK TERMINAL 1 (S)	
TS17 1	TO	JACK TERMINAL 6	7	TS27 1	TO	JACK TERMINAL 6	7
TS17 3	TO	JACK TERMINAL 2		TS27 3	TO	JACK TERMINAL 2	
TS17-4	TO	JACK TERMINAL 5		TS27-4	TO	JACK TERMINAL 5	
TS17-5	TO	JACK TERMINAL 3		TS27 5	TO	JACK TERMINAL 3	
TS17 6	TO	LAMP/RELAY TERMINAL B		TS26-6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T7	TO	JACK TERMINAL 7 (T)		TSN T7	TO	JACK TERMINAL 7 (T)	
TSL/F-R7	TO	JACK TERMINAL 4 (R)		TSN-R7	TO	JACK TERMINAL 4 (R)	
TSL/F-S7	TO	JACK TERMINAL 1 (S)		TSN S7	TO	JACK TERMINAL 1 (S)	
TS18-1	TO	JACK TERMINAL 6	8	TS28 1	TO	JACK TERMINAL 6	8
TS18-3	TO	JACK TERMINAL 2		TS28-3	TO	JACK TERMINAL 2	
TS18-4	TO	JACK TERMINAL 5		TS28-4	TO	JACK TERMINAL 5	
TS18-5	TO	JACK TERMINAL 3		TS28-5	TO	JACK TERMINAL 3	
TS18-6	TO	LAMP/RELAY TERMINAL B		TS28 6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T8	TO	JACK TERMINAL 7 (T)		TSN-T8	TO	JACK TERMINAL 7 (T)	
TSL/F-R8	TO	JACK TERMINAL 4 (R)		TSN-R8	TO	JACK TERMINAL 4 (R)	
TSL/F-S8	TO	JACK TERMINAL 1 (S)		TSN-S8	TO	JACK TERMINAL 1 (S)	
TS19-1	TO	JACK TERMINAL 6	9	TS29-1	TO	JACK TERMINAL 6	9
TS19-3	TO	JACK TERMINAL 2		TS29-3	TO	JACK TERMINAL 2	
TS19-4	TO	JACK TERMINAL 5		TS29-4	TO	JACK TERMINAL 5	
TS19 5	TO	JACK TERMINAL 3		TS29-5	TO	JACK TERMINAL 3	
TS19 6	TO	LAMP/RELAY TERMINAL B		TS29 6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T9	TO	JACK TERMINAL 7 (T)		TSN T9	TO	JACK TERMINAL 7 (T)	
TSL/F-R9	TO	JACK TERMINAL 4 (R)		TSN-R9	TO	JACK TERMINAL 4 (R)	
TSL/F-S9	TO	JACK TERMINAL 1 (S)		TSN-S9	TO	JACK TERMINAL 1 (S)	
TS20-1	TO	JACK TERMINAL 6	10	TS30-1	TO	JACK TERMINAL 6	10
TS20-3	TO	JACK TERMINAL 2		TS30-3	TO	JACK TERMINAL 2	
TS20-4	TO	JACK TERMINAL 5		TS30-4	TO	JACK TERMINAL 5	
TS20-5	TO	JACK TERMINAL 3		TS30-5	TO	JACK TERMINAL 3	
TS20-6	TO	LAMP/RELAY TERMINAL B		TS30-6	TO	LAMP/RELAY TERMINAL B	
TSL/F-T10	TO	JACK TERMINAL 7 (T)		TSN T10	TO	JACK TERMINAL 7 (T)	
TSL/F-R10	TO	JACK TERMINAL 4 (R)		TSN-R10	TO	JACK TERMINAL 4 (R)	
TSL/F-S10	TO	JACK TERMINAL 1 (S)		TSN-S10	TO	JACK TERMINAL 1 (S)	

[53]

[53]

TABLE 2 [54]

BCD WIRING EQUIPMENT SHELF TO DISPLAYS			BCD OUTPUT POSITION
TS1F-1 THRU TS1F-24	TO	J1F-1 THRU J1F-24	1
TS1N-1 THRU TS1N-24	TO	J1N-1THRU J1N-24	
TS1L-1 THRU TS1L-24	TO	J1L-1 THRU J1L-24	
TS2F-1 THRU TS2F-24	TO	J1F-1 THRU J1F-24	2
TS2N 1 THRU TS2N-24	TO	J1N-1 THRU J1N-24	
TS2L 1 THRU TS2L-24	TO	J1L-1 THRU J1L-24	
TS3F-1 THRU TS3F-24	TO	J1F-1 THRU J1F-24	3
TS3N-1 THRU TS3N-24	TO	J1N-1 THRU J1N-24	
TS3L-1 THRU TS3L-24	TO	J1L-1 THRU J1L-24	
TS4F-1 THRU TS4F 24	TO	J1F-1 THRU J1F 24	4
TS4N-1 THRU TS4N-24	TO	J1N-1 THRU J1N-24	
TS4L-1 THRU TS4L-24	TO	J1L-1 THRU J1L-24	
TS5F-1 THRU TS5F-24	TO	J1F-1 THRU J1F-24	5
TS5N-1 THRU TS5N-24	TO	J1N-1 THRU J1N-24	
TS5L-1 THRU TS5L-24	TO	J1L-1 THRU J1L 24	
TS6F-1 THRU TS6F-24	TO	J1F-1 THRU J1F-24	6
TS6N-1 THRU TS6N-24	TO	J1N-1 THRU J1N-24	
TS6L-1 THRU TS6L-24	TO	J1L-1 THRU J1L-24	
TS7F-1 THRU TS7F 24	TO	J1F-1 THRU J1F-24	7
TS7N-1 THRU TS7N 24	TO	J1N-1 THRU J1N-24	
TS7L-1 THRU TS7L-24	TO	J1L-1 THRU J1L-24	
TS8F 1 THRU TS8F-24	TO	J1F-1 THRU J1F-24	8
TS8N-1 THRU TS8N-24	TO	J1N-1 THRU J1N-24	
TS8L-1 THRU TS8L 24	TO	J1L-1 THRU J1L-24	
TS9F-1 THRU TS9F-24	TO	J1F-1 THRU J1F-24	9
TS9N-1 THRU TS9N-24	TO	J1N-1 THRU J1N-24	
TS9L-1 THRU TS9L 24	TO	J1L-1 THRU J1L-24	
TS10F 1 THRU TS10F-24	TO	J1F-1 THRU J1F-24	10
TS10N-1 THRU TS10N-24	TO	J1N-1 THRU J1N-24	
TS10L-1 THRU TS10L-24	TO	J1L-1 THRU J1L-24	

ENGINEERING NOTES

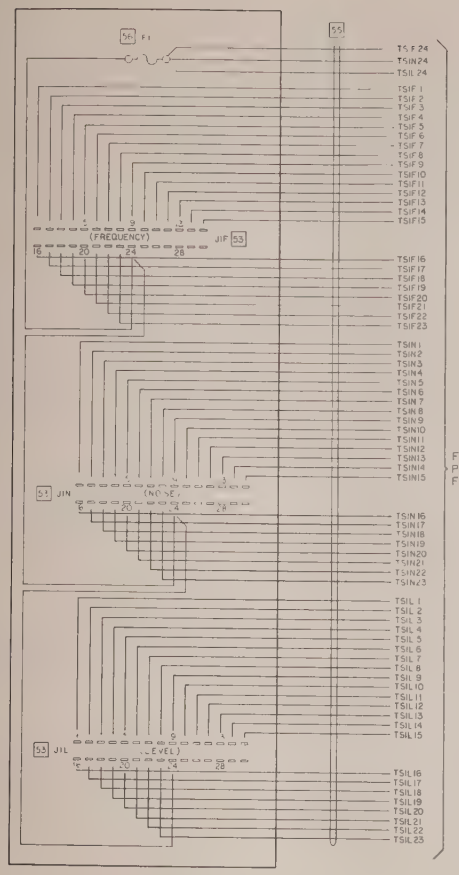
[51]

[52] TABLE 1 SHOWS EACH EQUIPMENT SHELF INPUT CHANNEL CONNECTED TO A SINGLE ACCESS POSITION JACK. FOR TYPICAL SINGLE INPUT SCHEMATIC, REFERENCE S1140-801 SHEET 2 FOR TYPICAL MULTIPLED INPUT SCHEMATIC REFERENCE S1140 801 SHEET 3

[53] CHANNEL 10 (dBm/kHz) AND (dBRN) ARE SHOWN CONNECTED FOR STANDARD JACK ACCESS. IF THE CALIBRATION STANDARD OPTION IS USED, CHANNEL 10 (dBm/kHz) AND (dBRN) MUST BE CONNECTED TO CALIBRATE KEY AS SHOWN ON S1140-801 SHEET 2, FIGURE 4 OR ON S1140 801 SHEET 3, FIGURE 8, OR T1140-805, FIGURE 4

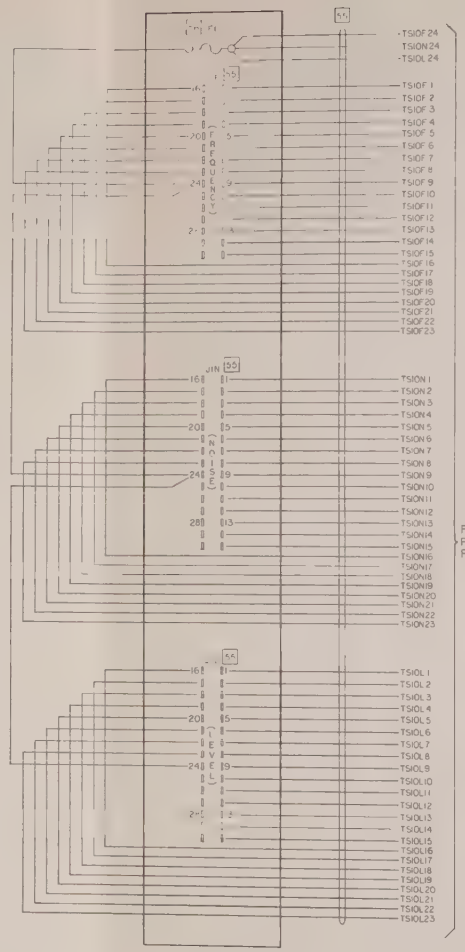
[54] CAUTION
IF DISPLAY ASSEMBLY CONTAINS FUSE F1, EQUIPMENT SHELF TERMINALS TS_F-24, TS_N-24, AND TS_L-24 MUST BE WIRED TO UNUSED TERMINAL OF THE FUSE BLOCK. IF DISPLAY ASSEMBLY DOES NOT CONTAIN FUSE F1, THE DISPLAY SHOULD BE WIRED AS SHOWN IN TABLE 2

TTi	1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM
DRAWING TITLE: CABLING DIAGRAM, WIRING TABLES	DRAWN BY: B G
	CHECKED BY: D G L
DRAWING NUMBER: T1140-B03	ISSUE: -02
	SHEET: 1 OF 1
	RELEASED BY: D.R.S.



FROM BCD OUTPUT POSITION NO. 1 FIGURE 1 T1140-B01

FIGURE 1
DISPLAY, TTI 1140A-2 LIST 8 OR TTI 1140A-2 LIST 12
(REAR VIEW) 52



FROM BCD OUTPUT POSITION NO. 1 FIGURE 1 T1140-B01

FIGURE 2
DISPLAY, TTI 1140A-2 LIST 9
(SIDE VIEW) 52

ENGINEERING NOTES

51

52 ALL CONNECTIONS USE WIRE WRAP TERMINALS (.062"X.031") TERMINAL SPACING .150 MINIMUM. USE BELL SYSTEMS WIRE WRAP TOOL, KS-16363 LIST 1 OR EQUIVALENT. REFERENCE GENERAL SYSTEMS PRACTICES SECTION 075-630-101, ISSUE 2, MARCH 1969 OR EQUIVALENT

53 RACK MOUNT DISPLAY TTI 1140A-2 LIST 8, CIRCUIT BOARD PART NUMBERS/EQUIPMENT CODE NUMBERS. (SEE TABLE A FOR PIN IDENTIFICATION.)

A.	FREQUENCY	P1140-028-02/TTI 1140C-2 LIST 2
B.	NOISE	P1140-026-02/TTI 1140D-2 LIST 7
C.	LEVEL	P1140-027-02/TTI 11408-2 LIST 3

54 AISLE MOUNT DISPLAY TTI1140A-2 LIST 9, CIRCUIT BOARD PART NUMBERS/EQUIPMENT CODE NUMBERS (SEE TABLE A FOR PIN IDENTIFICATION.)

A.	FREQUENCY	P1140-031-02/TTI 1140C-2 LIST 3
B.	NOISE	P1140-029-02/TTI 1140D-2 LIST 8
C.	LEVEL	P1140-030-02/TTI 1140B-2 LIST 4

55 **BCD INTERCONNECT CABLE:** 269A OR 257A (WECO), GT-17 50 PAIR (AUTOMATIC ELECTRIC), 24(1) 880 MOHAWK OR EQUIVALENT (BASIC CABLE REQUIREMENTS, 24 GAUGE, UNSHIELDED, 72 CONDUCTORS + SPARES MAXIMUM CABLE LENGTH 1000 FEET.) POSITIONS 2 THRU 9 ARE IDENTICAL IN ELECTRICAL CONNECTION TO POSITIONS 1 AND 10 SHOWN, (SEE TABLE C, J1140-002 SHEET 2)

56 PRIOR TO SOLDERING THE THREE -43VDC LEADS TO FUSE THE BLOCK, REMOVE AGC 1/4 FUSE, F1. SOLDER LEADS USING 35 WATT SOLDERING IRON AND RESIN CORE SOLDER ONLY. BUS WIRE CONNECTING FUSE BLOCK OUTPUT TO PIN 24 OF DISPLAY CONNECTORS (J1L-24, J1F-24, & J1N-24) IS PROVIDED

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM			
DRAWING TITLE: CABLING DIAGRAM, DISPLAYS (LIST 8, 9, 12)			DRAWN BY: B G
			CHECKED BY: D G L
DRAWING NUMBER: T1140-B04	ISSUE: -04	SHEET: 1 OF 2	RELEASED BY: D.R.S.

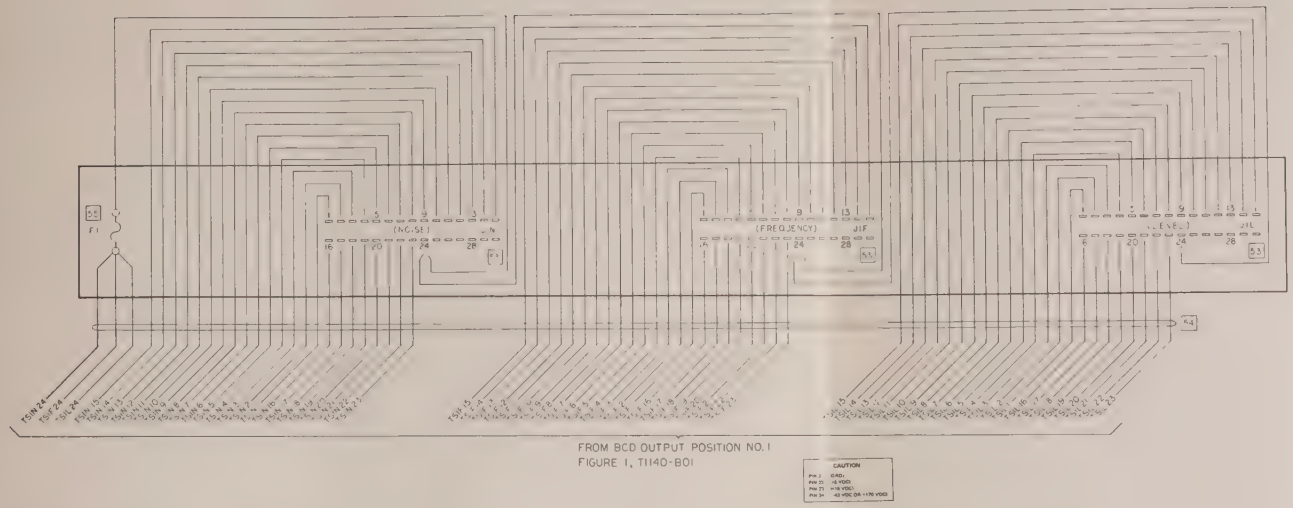


FIGURE 3

DISPLAY TTI 1140A-2 LIST 10 OR TTI 1140A-2 LIST 13 [52]

(REAR VIEW)

ENGINEERING NOTES

[51]

[52] ALL CONNECTIONS USE WIRE WRAP TERMINALS (.062"X.031") TERMINAL SPACING .150" MINIMUM. USE BELL SYSTEMS WIRE WRAP TOOL, KS-16363 LIST 1 OR EQUIVALENT. THIS DISPLAY IS SHOWN CONNECTED TO BCD OUTPUT POSITION NO. 1 ON T1140-B01. IN ACTUAL WIRING, ONLY ONE DISPLAY CAN BE CONNECTED TO A SINGLE OUTPUT POSITION AT THE EQUIPMENT SHELF

[53] PANEL MOUNT DISPLAY TTI 1140A-2 LIST 10 CIRCUIT BOARD PART NUMBERS/EQUIPMENT CODE NUMBERS (SEE TABLE A ON T1140-B04 SHEET 1 FOR PIN IDENTIFICATION)

- A. FREQUENCY P1140-028-02/TTI 1140C-2 LIST 2
- B. NOISE P1140-026-02/TTI 1140D-2 LIST 7
- C. LEVEL P1140-027-02/TTI 1140B-2 LIST 3

[54] BCD INTERCONNECT CABLE
269A OR 257A (WECO), GT-17 50 PAIR (AUTOMATIC ELECTRIC), 24 (1) 880 (MOHAWK) OR EQUIVALENT (BASIC CABLE REQUIREMENTS 24 GAUGE, UNSHIELDED, 72 CONDUCTORS + SPARES. MAXIMUM CABLE LENGTH 1000 FEET) (SEE TABLE C, J1140 002 SHEET 2.)

[55] PRIOR TO SOLDERING THE THREE -43VDC LEADS TO THE FUSE BLOCK, REMOVE AGC 1/4 FUSE, F1. SOLDER LEADS USING 35 WATT SOLDERING IRON AND RESIN CORE SOLDER ONLY. BUS WIRE CONNECTING FUSE BLOCK OUTPUT TO PIN 24 OF DISPLAY CONNECTORS (J1L-24, J1F-24, & J1N-24) IS PROVIDED

1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM			
DRAWING TITLE: CABLING DIAGRAM, DISPLAYS (LIST 10, 13)			DRAWN BY: B G
			CHECKED BY: D G L
DRAWING NUMBER: T1140-B04	ISSUE: -04	SHEET: 2 OF 2	RELEASED BY: D.R.S

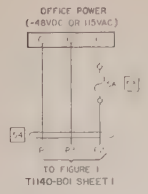


FIGURE 1

TABLE A		
POWER SUPPLY	CONDUCTOR	UTMS CONNECTION
115VAC TTI 1140A-2 L7	115VAC (BLACK) RETURN (WHITE) GROUND (GREEN)	P2 P1 P3
-48VDC TTI 1140A-2 L5	-48VDC 0 VDC (GROUND)	P2 P1

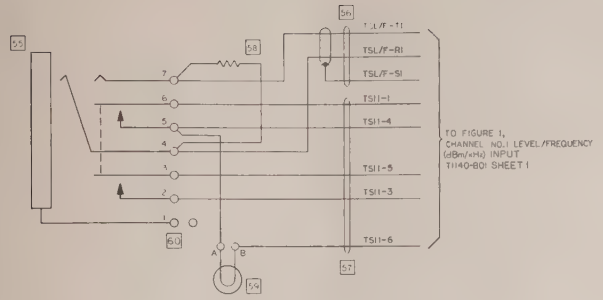


FIGURE 2 [52]

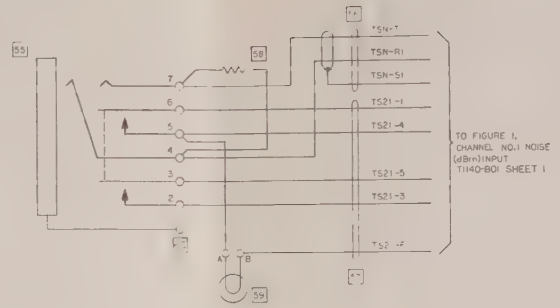


FIGURE 3 [52]

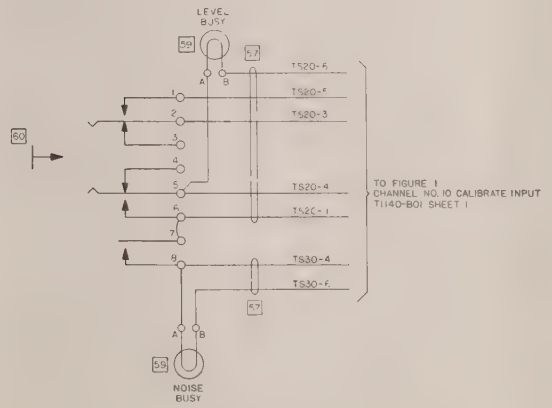


FIGURE 4 [52]

ENGINEERING NOTES

51

52 FIGURE 1 ON DRAWING T1140-801 SHEET 1 MAY BE INTERFACED THROUGH OTHER CUSTOMER INPUT CONFIGURATIONS. FIGURES 2, 3, AND 4 ARE TYPICAL EXAMPLES ONLY.

53 **FUSE**
WECO 70D, 35H OR EQUIVALENT FOR -48VDC OPERATION ONLY.

54 **POWER CABLE**
16 AM (WECO) OR EQUIVALENT (BASIC CABLE REQUIREMENTS 16 GAUGE SOLID TINNED COPPER 2 OR 3 CONDUCTORS). MAXIMUM CABLE LENGTH 250 FEET (SEE TABLE A). WHEN USING -48VDC POWER SUPPLY TTI 1140A-2 LIST 5 ENSURES TERMINALS P1 AND P3 ARE CONNECTED TOGETHER. (SEE TABLE A, J1140-002 SHEET 2.)

55 **JACK**
TO ACCEPT 310 TYPE PLUG USE (LENKURT) 139-10665-23, (WECO) 285A OR 324C, (TIMM) 90SN-288 OR EQUIVALENT. TO ACCEPT 309 TYPE PLUG USE (WECO) 323C, (TRIMM) 90CSN 538 OR EQUIVALENT.

56 **SIGNAL CABLE**
112 00152-05 (LENKURT), 24BF (WECO), T43M (GENERAL CABLE) OR EQUIVALENT. (BASIC CABLE REQUIREMENTS 24 GAUGE, SHIELDED PAIR, CAPACITY <20 pf FT., MAXIMUM CABLE LENGTH 250 FEET.) UNSHIELDED TIP (T) AND RING (R) LEADS NOT TO EXCEED 0.5 INCH SLEEVE(S) NOT TO BE GROUNDED AT JACK PANEL. GROUND ONLY AT 1140 EQUIPMENT SHELF INPUT CHANNEL(S) TERMINAL ONLY. (SEE TABLE D, J1140-002 SHEET 2.)

57 **CONTROL CABLE**
G.T.-17 (6 PAIR) (AUTOMATIC ELECTRIC); 252A OR 252CL (WECO) 24(1) BB (MOHAWK) OR EQUIVALENT (BASIC CABLE REQUIREMENTS 24 GAUGE UNSHIELDED, 5 CONDUCTORS + SPARES. MAXIMUM CABLE LENGTH 250 FEET.) (SEE TABLE D, J1140-002 SHEET 2.)

58 **TERMINATING RESISTANCE**

A. IF AT A PARTICULAR BAY LOCATION MORE THAN ONE TERMINATING RESISTANCE IS DESIRED THEN THE SECOND TERMINATION MUST BE TREATED LIKE A SECOND POSITION. (I.E. USE SEPARATE WIRING.)

B. USING SCANNING LOCKOUT SWITCH TTI 1140A-2 LIST 3 WHEN THE SCANNING LOCKOUT SWITCH IS USED, ANY COMBINATION OF 135, 600 OR 900 OHM TERMINATIONS MAY BE USED AT THE TEN INPUT CHANNELS AVAILABLE IN ONE SCANNING LOCKOUT SWITCH. THE TERMINATING IMPEDANCE CONNECTED AT THE JACK INPUT POSITION(S) MUST HAVE THE CORRESPONDING 1140 EQUIPMENT SHELF INPUT CHANNEL(S) (POSITIONS) ON THE STRAPPING CIRCUIT BOARD STRAPPED.

C. NO SCANNING LOCKOUT SWITCH. WHEN THE MULTIPLED CIRCUIT BOARDS ARE USED IN LIEU OF THE SCANNING LOCKOUT SWITCH TTI 1140A-2 LIST 3, ONE OF THE TERMINATIONS 135, 600 OR 900 OHMS CAN BE STRAPPED, HOWEVER ALL TEN INPUT CHANNELS (POSITIONS) WILL RECEIVE THE SAME IMPEDANCE STRAPPING COMMAND. THE SELECTED TERMINATING RESISTOR MUST BE PLACED AT THE ACCESS POINT FARTHEST FROM THE EQUIPMENT SHELF.

59 **LAMP SOCKET**
USE 478 (WECO), 247 (TRIMM) OR EQUIVALENT (CUSTOMER PROVIDED).

60 **KEY**
USE 547E (WECO) OR EQUIVALENT (CUSTOMER PROVIDED).

TTI 1140 UNIVERSAL TRANSMISSION MEASURING SYSTEM

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TTI warrants instruments manufactured by it to be free from defects in material and workmanship under normal use and service within specified ratings and operating conditions. Our obligation under this Warranty is limited to the repair or replacement, at TTI's sole discretion, of any instrument or part thereof which, when returned to TTI within one year of original shipment and upon our examination proves to be thus defective. This warranty includes the cost of return surface transportation from the factory. It does not include the cost of transportation to the factory and/or the cost of packaging the instrument for return to the factory, unless such instrument is returned within 30 days from the date of original shipment and prior written authorization for the reimbursement of such cost is obtained from the factory.

This Warranty shall not apply to any instrument which has been (1) repaired, worked on, or altered by persons not authorized by TTI so as, in TTI's sole judgement, to injure the stability, reliability, or proper operation of such instrument; (2) subjected to misuse, negligence, or accident; and (3) connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by TTI. Accessories, including, but not limited to fuses and batteries, not of TTI's manufacture, used or installed with this instrument are not covered by this Warranty.

TTI reserves the right to make changes in the design or construction of its instruments at any time without incurring any obligation to make these changes in instruments previously sold and delivered.

The repair or replacement of any part or parts of an instrument under this agreement does not void or extend the original Warranty period for the whole instrument. Repaired or replaced parts are warranted for the remainder of the instrument warranty period or for 90 days from the date of repair, whichever shall be longer.

We are not liable for consequential or incidental damages. This Warranty is in lieu of all others expressed or implied and no representative or person is authorized to assume for us any other obligations or liabilities in connection with the sale of TTI instruments and products.

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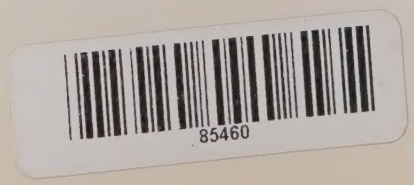
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